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RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
Detroit, Michigan

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CONTENTS

REACTIONS ASSOCIATED WITH INTRAVENOUS UROGRAPHY: HISTORICAL AND STATISTICAL REVIEW. *Henry P. Pendergrass, M.D., Roderick L. Tondreau, M.D., Eugene P. Pendergrass, M.D., David J. Ritchie, M.D., Eugene A. Hildreth, M.D., and Samuel I. Askovitz, M.D.* 1

THE NATURE OF THE TOXIC ACTION OF RADIOPAQUE DIAGNOSTIC AGENTS. *Peter K. Knoefel, M.D.* 13

REACTIONS FROM INTRAVENOUS ORGANIC IODIDE COMPOUNDS: PRETESTING AND PROPHYLAXIS. *Nathaniel Finby, M.D., John A. Evans, M.D., and Israel Steinberg, M.D.* 15

REACTIONS FOLLOWING EXCRETORY PYELOGRAPHY IN INFANTS AND CHILDREN. *Lawrence A. Davis, M.D.* 19

REACTIONS TO INTRAVENOUS ORGANIC IODINE COMPOUNDS AND THEIR IMMEDIATE TREATMENT. *John F. Weigen, M.D., and Sydney F. Thomas, M.D.* 21

OBSERVATIONS ON MASSIVE OSTEOLYSIS. A REVIEW OF THE LITERATURE AND REPORT OF A CASE. *Philip M. Johnson, M.D., and James G. McClure, M.D.* 28

MASSIVE OSTEOLYSIS DUE TO HEMANGIOMATOSIS. REPORT OF A CASE OF GORHAM'S DISEASE WITH AUTOPSY. *Rudolf Hambach, M.D., Jaroslav Pujman, M.D., and Vladimír Malý, M.D.* 43

NEUROFIBROMATOSIS: CLINICAL AND ROENTGEN MANIFESTATIONS. *Bertram Levin, M.D.* 48

THE ROENTGEN EXAMINATION OF THE LYMPHATICS IN MAN. *Dr. R. Gergely* 59

ROENTGENOLOGIC CHANGES OF THE SKELETAL SYSTEM IN CUSHING'S SYNDROME. *Willard J. Howland, Jr., M.D., David G. Pugh, M.D., and Randall G. Sprague, M.D.* 69

POSTERIOR MEDIASTINAL GOITER. *Jerome H. Shapiro, M.D., Harold G. Jacobson, M.D., F.A.C.R., Wilhelm Z. Stern, M.D., and Maxwell H. Poppel, M.D., F.A.C.R.* 79

TELEPAQUE OPACIFICATION OF RADIOLUCENT BILIARY CALCULI. THE "RIM SIGN." *Emanuel Salzman, M.D., and M. Robert Warden, M.D.* 85

CECAL INVAGINATION BY A MUCOCELE OF THE APPENDIX. *Matthew W. Elson, M.D.* 90

THE TREATMENT OF MYXOMATOUS CUTANEOUS CYSTS. *Robert B. Engle, M.D.* 93

X-RAY TRANSMISSION FACTOR IN ESTIMATING BONE DENSITY. *George P. Vose, M.S.* 96

VALUE OF THE PRONE POSITION FOR FILLING THE OBSTRUCTED URETER IN THE PRESENCE OF HYDRONEPHROSIS. *Jack Handel, M.D., and Solomon Schwartz, M.D.* 102

A NEW INTENSIFYING SCREEN-FILM COMBINATION FOR ANGIOCARDIOGRAPHY AND OTHER ROENTGENOGRAPHIC PROCEDURES. *Goffredo G. Gensini, M.D.* 104

EDITORIAL. REACTIONS TO INTRAVENOUS ORGANIC IODIDE COMPOUNDS. *Everett L. Pirkey, M.D.* 107

NATIONAL COMMITTEE ON RADIATION PROTECTION AND MEASUREMENTS. 108

ANNOUNCEMENTS AND BOOK REVIEWS. 110

IN MEMORIAM. 115

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES. 116

ABSTRACTS OF CURRENT LITERATURE. 120

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PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

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RADIOLOGY

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Reactions Associated with Intravenous Urography: Historical and Statistical Review

HENRY P. PENDERGRASS, M.D., RODERICK L. TONDREAU, M.D., EUGENE P. PENDERGRASS, M.D., DAVID I. RITCHIE, M.D., EUGENE A. HILDRETH, M.D., and SAMUEL I. ASKOVITZ, M.D.

WHILE INTRAVENOUS contrast studies, especially intravenous urography, have become one of our most valuable diagnostic measures, it is true, unfortunately, that the injection of any foreign substance into the human body always presents some hazard. As has been documented by previous surveys conducted by the members of the Department of Radiology of the Hospital of the University of Pennsylvania, both mild and severe reactions may follow the intravenous use of urographic media (8, 9). With the introduction of newer formulas for such contrast materials, it has seemed pertinent to evaluate again these unfavorable side-reactions. This report will deal primarily with the fatal reactions associated with intravenous urography.

Historically, it is interesting to note that, although retrograde pyelography was introduced early in the first decade of the twentieth century, it was not until 1923 that excretory urography was first attempted in animals. Osborne, Sutherland, Scholl, and Rowntree (6) obtained faint urograms employing a 10 per cent solution of sodium iodide either intravenously or orally. During the next five years other contrast media were developed, providing better shadows of the renal collecting systems without causing such symptoms as headache, nausea, and vomiting in almost every patient. In 1929, Uroselectan, discovered by Professor Binz and Doctor Räth (1), was introduced for intravenous urography by Swick of New York City, working in the laboratories of

TABLE I: FATALITIES ASSOCIATED WITH INTRAVENOUS UROGRAPHY SINCE 1930

	"Immediate" Deaths	Delayed or Indeterminate Deaths	Total Deaths
Previously Reported			
1930–42	17	20	37*
1942–52	27	6	33†
Total	44	26	70
Present Survey			
1942–52	16	1	17‡
1953–57 (April 6th)	61	8	69§
Total	77	9	86
1930–57			156

* Includes 11 fatalities reported in the literature by 11 authors (8): 7 "immediate" deaths and 4 delayed deaths.

† Includes 2 fatalities reported in the literature by 2 authors (3, 10); one of these occurred in an Army General Hospital in France (10). We considered these "immediate" deaths, based on our interpretation of the term "immediate."

‡ These 17 deaths for 1942–52 just discovered in present survey.

§ Includes 4 deaths reported in the U. S. literature (5, 7, 15) and 3 deaths in Canada.

[1] From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna. Presented as part of a Symposium on Reactions to Intravenous Organic Iodide Compounds at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17–22, 1957.

TABLE II "IMMEDIATE" DEATHS FOLLOWING INJ[illegible] A CONTRA[illegible]

Case No. and Year	Sex Age	Clinical Diagnosis and Findings	Contrast Medium Conc.	History of Allergy	Sensitivity Test Result	Speed of Injection	Time of Reaction	Character
1. 1953	F 30	Hypertension	Urokon 70%	Negative	Not done	Rapid	2–3 min.	Breathlessnes diac arrest
2. 1953	F 24	Back and groin pain	Diodrast 35%	Negative	I.V. Neg.	20 c.c. Rapid	Immedi	Retching, flus convulsions regular resp
3. 1953	M 27	0†	Diodrast 0	0	Eye 0	Slow	4 min.	Convulsions, apnea in 2 output nor
4. 1953	M 47	Right flank pain, subsiding epididymitis, essential hypertension	Urokon 35%	Asthma Previous IVP: no reaction	I.V. 0	Slow	Immedi	Flushing, agit ness of bres cyanosis, pu able
5. 1953	M 55	Obstipation (3 days), distended bladder, enlarged prostate	Urokon 70%	0	0	0	Immedi	Nausea, then half an hou signs of sho
6. 1953	F 30	High strung and nervous; many prior operations	Urokon 30%	0	0	0	10–15	Shock
7. 1953	M 80	Carcinoma of prostate, chronic valvular heart disease, arterial hypertension	Urokon 30%	Negative	Eye 0	Moderate	Immedi	Slight nausea face, took a became unc pulse
8. 1954	M 76	Arteriosclerotic heart disease	Urokon 70%	Negative	I.V. Neg.	Fairly fast	5 min.	Coma, cessati tion, shock,
9. 1954	M 55	Cystitis, hematuria	Urokon 70%	0	0	Slow	5 min.	Patient voide came cyano
10. 1954	M 59	Right renal calculus, healing myocardial infarction (1 month)	Urokon 70%	0	0	25 c.c. Slow	Immedi	Dyspnea, nau
11.* 1954	F 66	Multiple ureteral calculi, pyelonephritis. Electrocardiogram: ischemia	Urokon 70%	Negative Previous IVP: no reaction	0	25 c.c. Moderate	3 min.	Frothy sputu cyanosis, sh arrest
12. 1954	M 72	Suspected prostatic infection	Urokon 70%	Negative	Eye 0	Fast	3 min.	Cyanosis, no or pulse, be hour, dead half hours
13. 1954	M 55	Old myocardial infarct, G.I. hemorrhage, hematemesis	Urokon 70%	0	0	10 c.c. Moderate	10 min.	Nausea, vomi air hunger, ceased
14. 1954	M 80	Benign prostatic hypertrophy	Urokon 70%	Negative	Not done	Moderate	Immedi	Apnea, tachyc cyanosis, sh
15. 1954	M 0	0	Diodrast 35%	Negative 4 prior IVP's: no reaction	I.V. Eye Both neg.	Slow	Immedi	Shock, pulmo
16.* 1954	M 60	Tumor in dome of bladder	Urokon 70%	Previous skin reaction to sulfa	I.V. Neg.	24 c.c. Moderate	2–3 mi	Unconsciousn cardiac arre
17. 1954	F 0	Previous coronary attack	Diodrast 35%	Negative	I.V. Eye Neg.	0	29 min.	Collapse and
18. 1954	M 4 d.	Multiple congenital anomalies	Urokon 70%	Negative	Eye Neg.	15 c.c. Rapid	Immedi	Cyanosis, car 20 minutes
19. 1954	F 46	Pelvic mass	Diodrast 35%	Negative	I.V. Neg.	20 c.c. Slow	Immedi	Choking sensa chest
20. 1954	M 71	Cancer of penis? Nodules on ureter, arteriosclerotic heart disease	Urokon 30%	0	0	0	10–15	Chills
21. 1954	F 33	Hypertension	Urokon 70%	Negative Previous IVP's: no reaction	Not done	Fast	Immedi	Apprehension, cyanosis, no
22. 1954	M 71	Carcinoma of bladder	Urokon 70%	0 Previous IVP's: no reaction	Not done	Slow	Immedi	Cyanosis, sho
23. 1954	M 72	Weakness, hypertension	Diodrast 50%	Negative	Skin Neg.	20 c.c. Slow		
24. 1954	F 40	Hypertension	Urokon 70%	Negative	I.V. Neg.	20 c.c. Fast	4 min.	Sudden vasom shock and d
25. 1955	F 4 mo.	Congenital polycystic kidneys	Urokon 70%	Negative	I.V. Neg.	Moderate	Immedi	Circulatory ar collapse
26. 1955	M 51	Epigastric pain	Diodrast 35%	Negative	I.V. Neg.	5 c.c. Slow	Immedi	Cyanosis, dysp spasm
27. 1955	M 66	Gout and hypertension	Urokon 70%	Negative	I.V. 0	Slow	15 min.	Difficulty in h pain in legs,
28.* 1955	M 65	Hypertension	Urokon 70%	Negative	I.V. Neg.	25 c.c. Slow	10 min.	Shortness of b cyanosis, de
29. 1955	M 56	Chronic kidney infection	Urokon 70%	0	Buccal 0	0	Immedi	Cyanosis and during injec instantly
30. 1955	M 49	Abdominal pain, fever, elevated white blood count	Urokon 70%	0	0	15 c.c. 0	Immedi	Retching, cya
31. 1955	F 70	0	Hypaque 50%	Negative	I.V. Neg.	30 c.c. Fast	10 min.	Convulsions, a death

Character of Reaction	Treatment Employed	Time of Death	Autopsy Findings	Designated Cause of Death
Breathlessness, shock, cardiac arrest	Oxygen, epinephrine	10 min.	Not performed	Contrast medium
Retching, flush, tremors, convulsions, coma, irregular respirations	Epinephrine, oxygen, Coramine, fluids, supportive phenobarbital	26 hr.	Adrenal cyst	Contrast medium (possibly complicated by adrenal cyst)
Convulsions, coma, and apnea in 2 hr. Urinary output normal	0	5 days	Cerebral edema	0
Flushing, agitation, shortness of breath, wheezing, cyanosis, pulse unobtainable	Epinephrine I.V. and intracardiac oxygen, artificial respiration	10 min.	Not performed	Contrast medium
Nausea, then recovery in half an hour; suddenly signs of shock, death	Coramine I.V.	30 min.	Not performed	Vascular collapse. Uncertain
Shock	0	6–8 hr.	0	0
Slight nausea and flushed face, took a deep breath, became unconscious, no pulse	Epinephrine, oxygen, Vasoxyl	15 min.	Not performed	Vascular collapse. Uncertain
Coma, cessation of respiration, shock, cardiac arrest	Oxygen, artificial respiration, airway, epinephrine	3 hr.	Not performed	Contrast medium
Patient voided, then became cyanotic and died	Aminophylline, epinephrine, oxygen	20 min.	Not performed	Contrast medium
Dyspnea, nausea, shock	I.V. and I.M. epinephrine	10 min.	Healing myocardial infarction, right renal calculus, severe coronary sclerosis	Contrast medium. Coronary
Frothy sputum, coma, cyanosis, shock, cardiac arrest	Oxygen by mask and tube, I.V. epinephrine, cardiac massage	9–15 min.	Pulmonary edema, bilateral nephrocalcinosis	Contrast medium
Cyanosis, no blood pressure or pulse, better in half an hour, dead in one and a half hours	Artificial respiration, epinephrine, oxygen	1½ hr.	Not performed	0
Nausea, vomiting, shock, air hunger, respirations ceased	Oxygen, artificial respiration	15 min.	Multiple coronary infarcts, old and recent	Poor risk patient. Uncertain
Apnea, tachycardia, cyanosis, shock	Oxygen, neosynephrine, aminophylline	1 hr., 50 min.	Pulmonary edema, bilateral hydronephrosis	Contrast medium
Shock, pulmonary edema	0	Apparently rapid	0	Contrast medium
Unconsciousness, cyanosis, cardiac arrest	Oxygen, I.V. Benadryl, epinephrine. Coramine	15–20 min.	Marked edema of larynx, large edematous blebs in nasopharynx, papillary carcinoma of urinary bladder	Contrast medium
Collapse and rapid death	0	30 min.	0	Probably coronary
Cyanosis, cardiac arrest in 20 minutes	Oxygen, artificial respiration, later epinephrine	45 min.	Bilateral polycystic kidneys, septal defect in heart	Contrast medium
Choking sensation, pain in chest	0	5 min.	Pelvic abscess, no coronary or pulmonary emboli	Contrast medium
Chills	I.V. calcium gluconate	2–3 hr.	No cause for death demonstrated	Uncertain
Apprehension, coma, shock, cyanosis, no pulse	Oxygen, I.V. and intracardiac epinephrine	10 min.	No cause for death demonstrated	Uncertain
Cyanosis, shock	Oxygen, artificial respiration, I.V. and intracardiac epinephrine	30 min.	No cause for death demonstrated	Contrast medium
[illegible]ping, cardiac [illegible]	Oxygen, epinephrine, cardiac massage	2 hr.	Coronary arteriosclerosis, cardiomegaly, parathyroid adenoma	Contrast medium plus patient's disease
Sudden vasomotor collapse, shock and death	Oxygen, artificial respiration, epinephrine	8–10 min.	Not performed	Contrast medium
Circulatory and respiratory collapse	Oxygen, epinephrine, Levophed	10 min.	Polycystic kidneys, interventricular septal defect	Uncertain
Cyanosis, dyspnea, bronchospasm	Oxygen, artificial respiration, epinephrine	2–3 min.	Coronary sclerosis, left coronary occlusion	Contrast medium
Difficulty in holding breath, pain in legs, death	None	16–17 min.	Neparosclerosis, coronary sclerosis, coronary occlusion	Contrast medium
Shortness of breath, cyanosis, death	None	20 min.	Fresh myocardial infarct	Myocardial infarct
Cyanosis and convulsion during injection; died instantly	Epinephrine, Coramine	1 min.	Myocardial degeneration	0
Retching, cyanosis, shock	Oxygen, epinephrine, artificial respiration	20 min.	0	0
Convulsions, apnea, shock, death	Epinephrine, cardiac massage, oxygen	15 min.	0	Contrast medium. Patient's age

Cont. on p. 4

TABLE II "IMMEDIATE" DEATHS FOLLOWING INJECTION OF A CONTRAST

Case No. and Year	Sex Age	Clinical Diagnosis and Findings	Contrast Medium Conc.	History of Allergy	Sensitivity Test Result	Speed of Injection	Time of Reaction	Character of
32. 1955	M 83	Hematuria, thermal burn requiring leg amputation	Urokon 70%	Negative	Not done	Moderate	2 min.	Nausea, vomiti coma, gaspin tions, cardiac
33. 1955	M 52	? Recurrent renal calculus	Diodrast 35%	Negative	I.V. Neg.	Slow	2 min.	Shock, massive edema
34. 1955	M 65	Lymphosarcoma, ? renal involvement	Diodrast 35%	Negative	I.V. Neg.	Slow	40 min.	Shock, massive edema
35. 1955	F 44	Hypertension	Neo-Iopax 0	0	Eye Neg.	Moderate	15 min.	Labored breath pulse
36. 1955	M 79	G.I. bleeding, chronic renal disease, arteriosclerotic heart disease	Urokon 70%	Asthma	Skin I.V. Neg.	Slow	15–20 min	Warmth, pallor weak pulse, p
37. 1955	F 74	Abdominal aneurysm, previous renal disturbances	Hypaque 50%	Negative	I.V. Eye Neg.	Slow	5 min.	Foaming at mo arrest
38. 1955	F 26	Pelvic peritonitis	Urokon 70%	Negative	I.V. Neg.	14 c.c. Slow	Immedia	Vomiting, irreg ing and pulse arrest
39. 1955	M 84	Benign prostatic hypertrophy	Urokon 50%	Negativ	I.V. Neg.	25 c.c. Fast	1 min	Vomiting, dysp sis, cardiac a
40. 1955	F 76	Bizarre abdominal pain, congestive heart failure	Hypaque 50%	Negative	I.V. Neg.	30 c.c. Moderate	2–3 min.	Cyanosis, dyspn
41. 1956	F 37	Right flank pain, occasional vertigo	Diodrast 35%	Negative	I.V. Neg.	20 c.c. Slow	10 min.	Twitching, nerv sions, c atory failure
42. 1956	0 1 wk.	Premature (birth weight 2 pounds), clearing jaundice, peripheral edema	Urokon 70%	Negative	Not done	17 c.c. Fast	2 min.	Apnea and deat
43. 1956	M 61	Carcinoma of lung with metastasis	Urokon 70%	Negative	Not don	Moderate	10 min.	Cyanosis, depre tions and pul
44. 1956	M 60	3 weeks post-coronary	Hypaque 50%	Negative	Skin Neg.	Slow	25 min.	Peripheral vas ventricular fi death
45. 1956	M 72	Benign prostatic hypertrophy, hematuria, arteriosclerotic heart disease	Urokon 70%	Negative	I.V. Neg.	Moderate	3 min.	Ceased to breat tion (ventricu
46. 1956	M 56	Reticulum-cell sarcoma, generalized	Urokon 70%	Negative	Eye Neg.	22 c.c. Slow	5 min.	Chest and abdo unresponsive,
47. 1956	0 0	Known cardiac condition	Urokon 50%	0	I.V. Neg.	0	Immedia	Heart stopped died
48.* 1956	M 65	Left abdominal mass, hematemesis	Miokon 35%	Negative	I.V.	1 c.c. Slow	1 min. (r action test do	Laryngeal strid tion, convulsi
49. 1956	M 60	Abdominal mass, thought to be malignant, NPN = 33 mg. %	Miokon 50%	Negative	0 Neg.	0	Immedia	Choking feeling twitched, bre ceased
50. 1956	M 65	Hypertension	Urokon 35%	Negative	Skin Neg.	Slow	15 min.	Shallow breathi
51. 1956	M 35	Right lower quadrant pain	Urokon 50%	Negative	Eye I.V. Neg.	Slow	5 min.	Vasomotor shoc
52. 1956	M 44	V.R.I., stiffness and spasm of back, albuminuria 8 years ago	Hypaque 0	Asthma ?	0	5 c.c. Slow	Immedia	Dyspnea and cy opisthotonos
53. 1956	M 78	Incontinence of urine, widespread metastasis from carcinoma of buccal mucosa	Miokon 30%	Negative	I.V. Neg.	15 c.c. Slow	Immedia	Respirations ce
54. 1956	F 25	Sickle-cell anemia, suspected ectopic pregnancy	Hypaque 50%	Negative	I.V. Neg.	0	Immedia	Flushing, respir culty, shock,
55. 1956	M 61	Hypertensive cardiovascular disease	Urokon 30%	Negative	Skin 0	Slow	5 min.	Vascular and re collapse
56. 1956	M 62	Hematuria	Renografin 76%	Negative	I.V. Neg.	Slow	3 min.	Difficulty breat nosis, coma, c arrest
57. 1956	F 45	Arteriosclerotic heart disease, cardiac failure, precordial pain, bronchial asthma	Hypaque 50%	Asthma	I.V. Neg.	Slow	Immedia	Dyspnea and w gagging, cyan
58. 1957	M 74	Carcinoma of rectum, cardiovascular disease with mild failure	Hypaque 50%	Asthma	I.V. Neg.	Slow	Immedia	Did not feel wel breathing, cy back on table minutes
59.‡ 1954	M 56	High NPN = 125-150 mg. %	Diodrast 35%	Negative	Not done	Moderate	30–60 m	Pins and needle extremities, 3 complete colla minutes
60.‡ 1956	F 71	Orthopnea, right upper quadrant pain	Hypaque 50%	Allergic bronchitis	I.V. Neg.	Slow	Immedia	Cyanosis, breath cardiac and r arrest
61.‡ 1957	M 54	Low back pain	Miokon 0	0	0	Moderate	3 min.	Pruritus (gener cyanosis, loss sciousness

* These 4 cases reported in the literature, 2 by one author (4, 5, 13).

† Where "0" appears in the table, it indicates the desired information was not supplied.

‡ From Canada.

A CONTRAST MEDIUM FOR STUDY OF THE URINARY TRACT (CONTINUED)

Character of Reaction	Treatment Employed	Time of Death	Autopsy Findings	Designaeed Cause of Death
Nausea, vomiting, shock, coma, gasping respirations, cardiac arrest	Epinephrine, oxygen, Levophed	1 hr.	Not performed	Contrast medium. Pulmonary embolus
Shock, massive pulmonary edema	Antihistamine, epinephrine, oxygen	5 min.	Not performed	Contrast medium
Shock, massive pulmonary edema	Epinephrine, antihistamine, oxygen	5 min.	Not performed	Contrast medium
Labored breathing, absent pulse	Epinephrine, artificial respiration, oxygen	17 min.	No evidence of recent myocardial infarction	Cardiac failure. Contrast medium
Warmth, pallor, cyanosis, weak pulse, poor response	4–5 c.c. I.V. epinephrine, artificial respiration, oxygen	30–40 min.	Hydronephrosis of right kidney, no recent coronary occlusion	Contrast medium
Foaming at mouth, cardiac arrest	Coramine, oxygen, epinephrine, cardiac massage	48 hr.	0	0
Vomiting, irregular breathing and pulse, cardiac arrest	Oxygen, artificial respiration, cardiac massage	7 min.	Negative	Cardiac arrest. Uncertain
Vomiting, dyspnea, cyanosis, cardiac arrest	Oxygen, artificial respiration, cardiac massage	10 min.	Arteriosclerosis, coronary insufficiency, healed myocardial infarct	Patient's disease plus contrast medium
Cyanosis, dyspnea	Coramine, epinephrine, oxygen	5 min.	Not performed	Cardiac death, contrast medium
Twitching, nervousness, convulsions, coma, respiratory failure	Oxygen, I.V. fluids, epinephrine, Levophed	30 hr	Large recent hematoma in basal cisterns, edema of brain, recent infarct	Contrast medium plus patient's disease
Apnea and death	0	2 min.	Emphysema of lungs	Overdose of contrast medium plus patient's disease
Cyanosis, depressed respirations and pulse	I.V. epinephrine, oxygen	45 min.	Not performed	Contrast medium
Peripheral vascular collapse, ventricular fibrillation, death	I.V. fluids, cortisone, Levophed, epinephrine, cardiac massage	40 min.	Fresh myocardial infarction	Myocardial infarct
Ceased to breathe, fibrillation (ventricular)	I.V. fluids, epinephrine	20 min.	Not performed	Cardiac failure, contrast medium
Chest and abdominal pain, unresponsive, shock	I.V. fluids, cardiac massage	4½ hr.	Not performed	Cardiac failure, contrast medium
Heart stopped beating, died	0	2–3 min.	Heart damaged by hypertension, myocardial fibrosis	Coronary occlusion
Laryngeal stridor, excitation, convulsions, shock	Intratracheal oxygen, supportive measures	5–20 min.	Not performed	Contrast medium
Choking feeling, foot twitched, breathing ceased	I.V. antihistamines, Nembutal, Levophed, oxygen	5 min.	0	Contrast medium
Shallow breathing, coma	I.V. Benadryl, oxygen, tracheal suction	30 min.	0	Contrast medium
Vasomotor shock	Oxygen, antihistamines, artificial respiration, epinephrine	30 min.	Equivocal	Contrast medium
Dyspnea and cyanosis, opisthotonos	0	2–3 min.	Fatty infiltration of myocardium	Contrast medium plus patient's disease
Respirations ceased	Epinephrine, Benadryl, artificial respiration, oxygen	Immediate	Bronchopneumonia with widespread metastasis	Contrast medium plus patient's disease
Flushing, respiratory difficulty, shock, tachycardia	Epinephrine, oxygen	0	0	0
Vascular and respiratory collapse	Oxygen, artificial respiration, stimulants	20 min.	Fresh myocardial infarction	Myocardial infarction
Difficulty breathing, cyanosis, coma, cardiac arrest	Epinephrine, airway	15 min.	Coronary arteriosclerosis, acute pyelonephritis	Non-committal; contrast medium
Dyspnea and wheezing, gagging, cyanosis	Artificial respiration, I.V. epinephrine	40 min.	Status asthmaticus	Contrast medium
Did not feel well, difficult breathing, cyanosis, fell back on table in 3 minutes	Oxygen, epinephrine	6 min.	Not performed	Contrast medium
Pins and needles feeling in extremities, 30 minutes; complete collapse, 60 minutes	Oxygen, epinephrine	1½ hr.	Probable anaphylactoid reaction	Contrast medium plus patient's disease
Cyanosis, breathlessness, cardiac and respiratory arrest	Oxygen, epinephrine	3 min.	Anaphylactic shock during urography	Contrast medium
Pruritus (generalized) and cyanosis, loss of consciousness	Oxygen	1½ hr.	Edema of trachea, epiglottis and lung fields	Contrast medium

Professor Lichtwitz in Germany (11, 12). Work with this new medium was continued on the urologic service of Professor von Lichtenberg (Berlin), who reported its use in 84 cases with no unusual side-effects (4). In 1932 another compound, per-abrodil (Diodrast), manufactured by the T. G. Farbenindustrie (13) was introduced, and by 1933 the Schering Corporation was producing Uroselectan B (Neo-Iopax) commercially. These two latter compounds were employed in the majority of urographic procedures performed in the United States over the next twenty years.

In previous publications (8, 9) we have documented 70 urographic deaths from 1930 through 1952, including 13 reported by other authors. Our most recent survey of the membership list of the American College of Radiology, as well as of the various interested pharmaceutical companies, has disclosed another 86 fatalities associated with intravenous urography. Sixty-nine of these occurred after 1952 (Jan. 1, 1953, to April 6, 1957), while 17 belonged in the years 1942 through 1952 but had not been included in our survey for that period. Four of the 69 more recent deaths reported to us have been published elsewhere (5, 7, 15) but are included in our study for completeness and for statistical purposes.

Table I shows the classification of 156 intravenous urographic fatalities since 1930, including the 86 discovered in our present survey.

As in our previous surveys, the deaths are classified as *immediate, delayed, and indeterminate.* An immediate death is defined as one following a reaction which developed during the urographic examination. Seventy-seven *immediate* deaths (61 of these since 1952) were found in our recent survey. Pertinent information abstracted from the case reports of each of the 61 *immediate* fatalities since 1952 is included in Table II. *Delayed* deaths are those occurring in patients who exhibited their first reaction over an hour after the injection of the contrast medium and died later. The *indeterminate* deaths included those which could not be evaluated because of insufficient data. Nine deaths (8 since 1952) were considered to be either *delayed* or *indeterminate* and therefore will be referred to only briefly because of the difficulty in establishing a direct cause-and-effect relationship between the reactions and the injection of the contrast medium.

As we have noted previously, along with other investigators, it frequently is difficult to establish the contrast medium as the major etiological factor even when the death occurs immediately after injection. Three episodes reported to us in the present survey illustrate this graphically. Two patients had coronary attacks and expired just before injection of the contrast medium. (Two similar cases were noted in our previous survey.) If the coronary attacks had occurred only a few minutes later, death would probably have been attributed to the contrast medium. In the third instance, a 28-year-old male with widespread metastases went into shock about five minutes following the intravenous injection of 30 c.c. of Hypaque and died in about four hours, despite strenuous supportive therapy (2). At autopsy, multiple large hemorrhagic nodules were found in the liver, the largest measuring 7 cm. in diameter. Blood gushed from a rent in this nodule when the liver was compressed. An estimated 3,500 c.c. of bloody fluid was present in the peritoneal cavity. The clinical picture presented by this patient was similar in many ways to that attributed to the injection of urographic contrast media, but it is believed that his demise was undoubtedly due to hemorrhage from the spontaneous rupture of the metastatic nodule in the liver.

METHOD OF SURVEY

In the present survey, a questionnaire was addressed to 4,106 members and fellows of the American College of Radiology asking them to state the number of fatal reactions to urography which had occurred in either their offices or hospital practice. Replies were received from 2,786

of the 3,935 College members in the continental United States—a response-rate of 70.8 per cent (Table III). This compares very favorably with the response-percentages of 35 and 41.5 for our 1942 and 1952 surveys, respectively. Many replies were also received from our colleagues in Canada and in the U. S. territories. Three of the 69 more recent fatalities occurred in Canada.

TABLE III: QUESTIONNAIRES CONCERNING UROGRAPHIC FATALITIES SENT TO THE MEMBERSHIP OF THE AMERICAN COLLEGE OF RADIOLOGY

Total number of questionnaires sent	4,106
Per cent response to questionnaires	70.77
Continental United States	
Questionnaires sent	3,935
Replies received	2,786
Per cent response	70.8
United States Possessions and Foreign	
Questionnaires sent	171
Replies received	120
Per cent response	70.1

Eighty-eight radiologists returned cards indicating the occurrence of a total of 106 fatal reactions to the injection of urographic contrast media. Subsequently, follow-up letters were sent to each of these physicians requesting more specific details on each of the fatalities, in an effort to eliminate duplicate reports, as well as those included in our previous survey. The type of information requested was as follows:

1. Date
2. Age, sex
3. Clinical evaluation
4. Contrast medium and concentration
5. Allergy history
6. Sensitivity test result
7. Speed of injection
8. Interval between injection and reaction
9. Reaction description
10. Treatment employed
11. Interval until death
12. Roentgen findings
13. Autopsy findings
14. Radiologist's opinion as to cause of death

The date of the fatal reaction, as well as the age and sex of the patient, and the type of contrast medium employed aided us in discarding duplicate cases. Twenty-seven of the 106 cases were discarded, either because they had already been included in one of our previous surveys or because insufficient information was available to establish a relationship between the injection of the contrast medium and death. An occasional radiologist returned the follow-up questionnaire saying that he was mistaken and that he had meant to report only a severe nonfatal reaction. Seventeen radiologists who had reported 21 of the 106 deaths, failed to reply to two or more follow-up letters; of these fatalities for which full details were not obtained, 3 were reported by Canadian radiologists. Adequate information was received on the remaining 58 fatalities in this group of 106. As shown in Table IV, 17 of these occurred during the years 1942 through 1952 and, as already stated, were not discovered in our previous survey of that period; 41 occurred after Dec. 31, 1952; 3 of these in Canada. Three cases (one prior to 1953) were classified as *delayed* or *indeterminate*.

TABLE IV: ANALYSIS OF 106 UROGRAPHIC FATALITIES REPORTED BY 88 RADIOLOGISTS

Deaths 1942–1952 not included in our previous survey for this period	17
Deaths Jan 1, 1953, to April 6, 1957	41*
Discarded because:	
(*a*) reported in our previous survey (*b*) insufficient information available (*c*) severe *nonfatal* reactions	27
No follow-up answer from 17 radiologists reporting the following number of deaths	21*

* Includes 3 cases in Canada.

An additional 28 urographic fatalities occurring after Dec. 31, 1952, not previously known to us, were supplied by the medical directors of various interested pharmaceutical companies; we classified 6 deaths in this group as *delayed* or *indeterminate*.

Sixty-one of the 69 fatalities since 1952, reported by radiologists and by the drug companies, are classified as *immediate* (Table V). Even though in a number of cases the reporting physician listed the cause of death as uncertain, there appeared to be at least a possible cause-and-effect relationship between the side-reaction and the urographic procedure in each of the 61 *immediate* fatalities occurring after 1952.

TABLE V: SOURCE OF REPORTS OF UROGRAPHIC FATALITIES SINCE 1952*

	"Immediate" Deaths	Delayed or Indeterminate Deaths	Total Deaths
Members of the American College of Radiology	39†	2	41
Pharmaceutical companies	22	6	28
	61	8	69

* Jan. 1, 1953, to April 6, 1957.
† Includes 3 deaths in Canada.

"Contrast medium" was definitely mentioned as a responsible factor in 41 of the 61 cases. In our opinion, the contrast medium was also a definite factor in the majority of the cases classified as "uncertain" or as "patient's disease" (Table VI).

TABLE VI: DESIGNATED CAUSE OF DEATH IN 61 "IMMEDIATE" UROGRAPHIC FATALITIES SINCE 1952*

Contrast medium	26
Contrast medium plus patient's disease	15
Patient's disease	5
Patient's disease and uncertain	3
Uncertain	12†
Total	61

* Jan. 1, 1953, to April 6, 1957.
† Includes 4 uncertain, 1 noncommittal, and 7 not stated.

The contrast media employed in the 25 cases with *immediate* death in our 1952 survey report were as follows: Diodrast, 20 patients; Neo-Iopax, 3 patients; Urokon, 1 patient; Neo-Iopax and Diodrast, 1 patient. It should be noted, however, that the two most commonly used media were Diodrast and Neo-Iopax. Diodrast was also employed in the 2 published case reports of urographic fatalities appearing during this period (3, 10). In the 61 recent *immediate* deaths (since 1952), Urokon was employed most frequently (Table VII). Unfortunately we have no breakdown at this time on the relative frequency of the use of the various contrast media. It should be noted that both Miokon and Renografin are fairly new compounds and are perhaps at the same relative stage of use as Urokon was

TABLE VII: CONTRAST MEDIA EMPLOYED IN CASES WITH "IMMEDIATE" UROGRAPHIC DEATHS, 1942–57

Medium Employed	1942–52	Since 1952*	Total
Diodrast (Winthrop Laboratories)	32	11	43
Neo-Iopax (Schering Corporation)	7	1	8
Diodrast and Neo-Iopax	1	..	1
Urokon (Mallinckrodt Chemical Works)	3	36	39
Hypaque (Winthrop Laboratories)	..	8	8
Miokon (Mallinckrodt Chemical Works	..	4	4
Renografin (E. R. Squibb & Sons	..	1	1
Total patients	43†	61‡	104

* Jan. 1, 1953, to April 6, 1957.
† Includes 25 cases studied in previous survey, 2 cases reported in the literature (3, 10), and 16 additional cases for 1942–52 discovered in present survey.
‡ Includes 4 cases reported in the literature by 3 authors (5, 7, 15).

in 1952, when only 1 death was reported related to its use.[2] Hypaque has been on the commercial market a little longer than either Miokon or Renografin; 8 deaths from Hypaque are listed since 1952. Our data are not sufficient to determine relative toxicities of the various contrast substances, but it is apparent that at least one fatality has occurred from each of the urographic media in common use today (Table VII).

Previously it was observed that reactions might occur after the injection of only 2 c.c. of the contrast medium. This was also noted in the present survey. In fact, the majority of reactions came either during the injection or in the succeeding five-minute interval (Table VIII). In 1

TABLE VIII: TIME OF REACTION AFTER INJECTION OF CONTRAST MEDIUM IN "IMMEDIATE" UROGRAPHIC FATALITIES SINCE 1952*

Time	Number of Patients
0–5 minutes	46
6–10 minutes	6
11–15 minutes	4
16–60 minutes	5

* Jan. 1, 1953, to April 6, 1957.

[2] A total of 3 deaths from Urokon are listed for 1952 in Table VII because 2 additional cases were found subsequent to the publication of our 1952 survey.

TABLE IX: DISTRIBUTION OF THE 61 "IMMEDIATE" UROGRAPHIC FATALITIES SINCE 1952, BY AGE AND SEX

	Under 1 year	1–20	21–40	41–60	61 and over	Unknown
Male	1	.	2	16	21	1
Female	1	.	8	3	5	1
No record	1	.	..	..	..	1
Total	3	0	10	19	26	3

case reported in the literature (7), and included in our present survey, there was a reaction within one minute to a 1 c.c. test dose of 35 per cent Miokon (Case 48).

The distribution of reactions in the 61 *immediate* urographic fatalities since 1952, as far as age and sex are concerned, is shown in Table IX, and the speed of injection of the contrast medium as reported by the attending physician is tabulated in Table X.

TABLE X: SPEED OF INJECTION OF CONTRAST MEDIUM IN 61 "IMMEDIATE" UROGRAPHIC FATALITIES SINCE 1952

	Number of Patients
Rapid (0 to 1.5 minutes)	11
Moderate (1.5 to 4.5 minutes)	13
Slow (over 4.5 minutes)	28
No record	9

The dose of the contrast medium should be considerably reduced in infants and young children. An overdose may have contributed to at least 2 deaths reported to us in the current survey. When dealing with children, we follow a dosage-schedule suggested by Dr. John W. Hope, Children's Hospital, Philadelphia (Table XI).

As stated previously, pretesting for hypersensitivity has been of no practical value in our hands. A negative sensitivity test should not be permitted to give the attending physician a false sense of security. Negative sensitivity tests were recorded in most of the *immediate* fatalities reported to us (Table XII). As has been noted by Trattner and his associates (14), severe reactions may be precipitated by the intravenous injection of only a small amount of a 10 per cent solution of the contrast medium. We know of instances where a severe reaction in the eye followed a conjunctival sensitivity test. One physician reported that he had recently encountered a profound "anaphylactoid" reaction to only 0.1 c.c. of intracutaneous Hypaque; the patient went into severe shock and recovered only after being maintained for some time on Levophed. Failure to do pretesting is not to be regarded as neglecting the welfare of the patient. It should be emphasized again that *"a careful clinical history, with particular emphasis upon allergy, and studied clinical judgment still remain the*

TABLE XI: DOSAGE OF CONTRAST MEDIUM EMPLOYED FOR INTRAVENOUS UROGRAPHY IN CHILDREN*

Premature	4 c.c.
Newborn–3 months	4–6 c.c.
3–6 months	6–8 c.c.
7 months–2 years	9–15 c.c.
3–6 years	16–20 c.c.
Over 6 years	20–25 c.c.

* Dosage schedule suggested by Dr. John W. Hope, Children's Hospital, Philadelphia, Penna., and followed at the Hospital of the University of Pennsylvania.

TABLE XII: SENSITIVITY TESTS PERFORMED OR NOT PERFORMED PRIOR TO "IMMEDIATE" UROGRAPHIC FATALITIES

	1942–52*	1953–57†	Total
Test Performed			
Intravenous	5	26	31
Conjunctival	5	6	11
Skin	6	4	10
Intraoral	1	0	1
Buccal	0	1	1
Conjunctival, skin and intravenous	1	0	1
Conjunctival, skin and tongue	1	0	1
Conjunctival and intravenous	1	4	5
Intraoral and intravenous	1	0	1
Conjunctival and skin	5	0	5
Skin and intravenous	0	1	1
Type of test not stated	0	1	1
Test not performed	12	8	20
No record	5	10	15
Total patients			104

* Includes 25 patients studied in previous survey, 2 cases reported in the literature (3, 10), and 16 additional cases for 1942–52 discovered in present survey.

† Jan. 1, 1953, to April 6, 1957, including 4 cases in the literature (5, 7, 17).

There was one fatal reaction to an intravenous sensitivity test (case 48) in the present survey. It was assumed that all of the other tests were negative unless a specific statement was made to the effect that there was a positive reaction.

sine qua non in this field of medical practice" (9).

TREATMENT OF REACTIONS FOLLOWING INTRAVENOUS UROGRAPHY

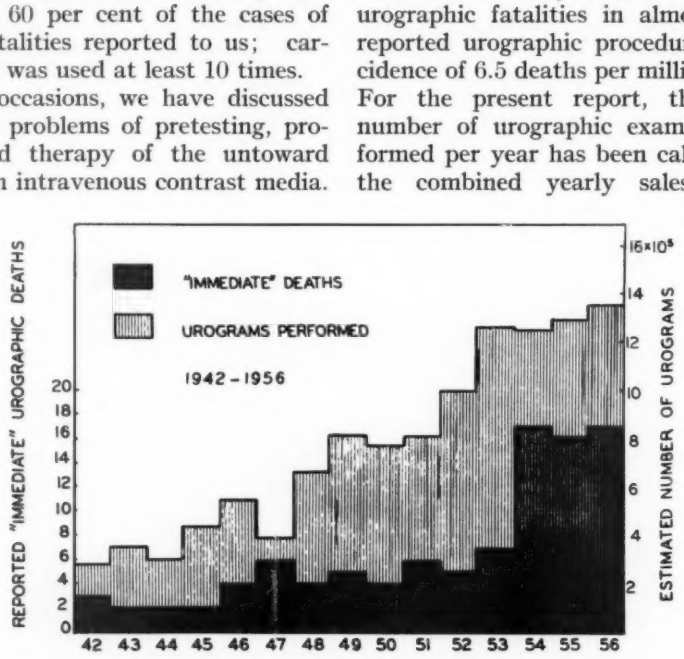
Epinephrine (adrenalin chloride) was employed in 60 per cent of the cases of *immediate* fatalities reported to us; cardiac massage was used at least 10 times.

On other occasions, we have discussed in detail the problems of pretesting, prophylaxis, and therapy of the untoward sequelae from intravenous contrast media. It has been necessary to modify our former suggestions somewhat along lines which will be recommended by other members of this symposium.

It is planned that a future publication from this department will discuss in greater detail both prophylaxis and therapy, but mention should be made at this time of the use of epinephrine. Previously, it was stated that administration of epinephrine in the presence of anoxia might cause ventricular fibrillation. Examination of the fatal reactions reported to us in this recent survey, however, seems to indicate that the majority are anaphylactoid in type. Since such reactions usually respond dramatically to epinephrine, it would certainly seem that use of this drug should not necessarily be contraindicated in the presence of an acute allergic reaction.

STATISTICAL ANALYSES

The 1952 survey disclosed 25 *immediate* urographic fatalities in almost 4,000,000 reported urographic procedures or an incidence of 6.5 deaths per million urograms. For the present report, the estimated number of urographic examinations performed per year has been calculated from the combined yearly sales figures of urographic contrast media. This information was generously supplied by the manufacturers. In our Department of Radiology about 18 per cent of the supply of urographic contrast material is employed for other special procedures. By reducing the actual sales figures by 20 per cent, to account for breakage as well as for specialized procedures, it was felt that we might arrive at the approximate number of urographic examinations performed annually in the United States. According to this method, the estimated number of urograms for the eleven-year period (1942 through 1952) is 6,372,000. The 42 known *immediate* urographic fatalities[3] for that



Graph 1. Annual relationship between the reported number of "immediate" urographic fatalities and the estimated number of urographic procedures in the United States from Jan. 1, 1942, to Dec. 31, 1956.

[3] Excluded is 1 case from the American literature, as it occurred in an Army General Hospital in France.

period represent an incidence of 6.6 deaths per million estimated urograms (Table XIII). This is amazingly close to the 6.5 figure obtained in our last survey, when the number of urograms was reported by the physicians instead of by the manufacturers. The similarity of these two figures encouraged us to consider the 80 per cent figure of urographic contrast media sales a fairly accurate estimate of the number of studies performed.

TABLE XIII: INCIDENCE OF "IMMEDIATE" UROGRAPHIC FATALITIES PER MILLION UROGRAPHIC EXAMINATIONS

Previous survey 1942–52 (Membership American College of Radiology): 25 deaths per 3,831,850 (reported) urograms	6.5
Total 1942–52 experience, United States 42 deaths* per 6,372,200 (estimated) urograms	6.6

* Includes the 25 deaths referred to above plus 1 death reported in the literature (3) and 16 additional deaths for this period just discovered in current survey.

Urograms estimated on 80 per cent of sales of urographic contrast media during this period. Information supplied by the manufacturers.

Graph I illustrates the annual relationship between the *reported* number of *immediate* urographic fatalities and the estimated number of urographic procedures in the United States from Jan. 1, 1942, to Dec. 31, 1956.[4] The 57 *immediate* fatalities reported for the years 1953 through 1956 represent a marked absolute increase over the 42 *immediate* deaths noted in the previous eleven years. Three deaths were reported in 1942 as compared to 16 or 17 deaths in each year of the last three-year period, 1954 to 1956 inclusive. When related to the increased employment of urography, however, the increasing death figure seems less striking. There was a fivefold increase in the estimated number of urographic procedures from 280,000 in 1942 to 1,368,000 in 1956. Over the entire fifteen-year period, the total incidence of reported deaths following urography came to 8.6 per million urograms. The incidence on an annual basis varied from a low of 3.9 per million to a high of 15.3 per million (Table XIV). With one exception, the annual figures fall within two standard deviations of the mean for the whole period. Thus, no significant difference has been demonstrated in the rate of occurrence of urographic deaths.

[4] Excluded are 3 cases from Canada, 1954, 1956, and 1957 respectively, and 1 case from the United States, 1957.

TABLE XIV: ANNUAL NUMBER OF REPORTED "IMMEDIATE" UROGRAPHIC DEATHS AND ESTIMATED ANNUAL NUMBER OF UROGRAPHIC PROCEDURES IN THE UNITED STATES, 1942–56 INCLUSIVE

Year	Number of Urographic Deaths	Estimated Urograms Performed	Deaths per Million Urograms
1942	3	280,000	10.7
1943	2	352,000	5.7
1944	2	298,000	6.7
1945	2	434,000	4.6
1946	4	474,000	8.4
1947	6	392,000	15.3*
1948	3	721,000	4.2
1949	5	815,000	6.1
1950	4	768,000	3.9
1951	6	810,000	7.4
1952	5	1,028,000	3.9
1953	7	1,268,000	5.8
1954	17	1,233,000	13.8
1955	16	1,315,000	12.1
1956	17	1,368,000	12.4
Total	99	11,546,000	8.6

* With the exception of this year, all annual rates fall within *two standard deviations* of the mean of 8.6.

SUMMARY

1. A recent survey has revealed a total of 86 deaths associated with the procedure of intravenous urography.

2. Seventeen of these 86 urographic deaths occurred during the years 1942 through 1952, but were not included in our previous survey of that period, as we did not have record of them until the present survey.

3. Of the 69 urographic fatalities which occurred between Jan. 1, 1953, and April 6, 1957, 61 were *immediate* deaths. The histories of these 61 cases have been abstracted and data are shown in tabulated form.

4. Mention only is made concerning our changing concept of prophylaxis and treatment for patients undergoing urographic studies with contrast media; this will be discussed in greater detail in a supplemental publication.

5. While the absolute number of urographic fatalities per year has increased over the four-year period 1953 to 1956, inclusive, it would appear that this increase is related to the greater employment of urography and not necessarily to any increased toxicity of the urographic contrast media.

NOTE: For co-operation and assistance in supplying the data presented in this report the authors are indebted to many radiologists and to the Medical Directors, Associate Directors, and Chemists of the following pharmaceutical concerns: Mallinckrodt Chemical Works, Melvin A. Thorpe, Director, Product Development; Schering Corporation, G. Kenneth Hawkins, M.D., Division of Clinical Research; The Squibb Institute for Medical Research, Mark H. Lund, M.D., Associate Medical Director; Winthrop Laboratories, E. J. Foley, M.D., Medical Director.

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SUMMARIO IN INTERLINGUA

Reactiones Associate Con Urographia Intravenose. Revista Historic E Statistic

Le autores reporta un revista de mortes urographic, supplementante duo previe reportos que coperiva le annos ab 1930 usque a 1952. Questionarios adressate a omne le membros del Collegio American de Radiologia e al interessate fabricantes pharmaceutic revelava 86 casos de morte associate con urographia intravenose. Sexanta-nove de istos occurreva post 1952, durante que 17 esseva de datas anterior sed non habeva essite includite in le previe reportos.

Inter le mortes que ha occurrite depost 1952, 61 esseva "immediate," i.e. illos culminava un reaction que se disveloppava in le curso del examine urographic. Illos es considerate como relationate a effectos del substantia de contrasto.

Le substantias de contrasto usate e le numeros del mortes associate con illos esseva: Urokon (36), Diodrast (11), Hypaque (8), Miokon (4), Neo-Iopax (1), e Renografin (1). Tamen, le frequentia relative del uso del varie substantias non es cognoscite.

Durante que le numero absolute del mortes urographic monstra un tendentia augmentatori in recente annos, le cifras debe esser considerate in le lumine del facto que le uso de technicas urographic ha devenite multo plus frequente. Assi il es possibile asserer que le presente studio non indica un significative alteration del incidentia de mortes occurrente in consequentia de urographia intravenose.

The Nature of the Toxic Action of Radiopaque Diagnostic Agents[1]

PETER K. KNOEFEL, M.D.

THE QUESTION HAS been asked, "What is toxicity?" A reply comes from the answer to another question: What is the dose of a drug? The answer is: "Enough!" Enough to lead either to the desired result or to an undesired result. In the latter instance we have toxicity. We wish to know the nature of the toxicity of radiopaque diagnostic agents, but so little information is available that discussion must be largely speculative.

The first approach is the statistical one, as shown in Figure 1. This is the characteristic curve of the acute lethal toxicity of iodopyracet in the rat, taken from the data of Hoppe, Larsen, and Coulston (1). It is plotted on "logarithmic probability" paper, on which the abscissa represents the dose on a logarithmic scale and the ordinate is the percentage mortality on a scale that is multiples of the standard deviation from the average lethal dose, the LD 50, which is seen to be 6 gm. per kilogram of body weight. The point at the lower left is the approximate observed mortality in man of iodopyracet, about 1 in 100,000 at the usual dose of 20 c.c. of a 35 per cent solution, which is approximately 0.12 gm. per kilogram. This is taken from the report of Pendergrass, *et al* (2). The dose expected to give this mortality in the rat is about 4 gm. per kilogram.

There are three explanations (at least) for these observations which must be considered. The first is that all people are more sensitive than all rats, but show the same frequency distribution of sensitivity. This would move the characteristic curve over to give an LD 50 of about 0.2 gm. per kilogram, or about 33 c.c. of the 35 per cent solution. This is probably not the LD 50 in man. Further evidence against this is that the LD 50 of these radiopaque

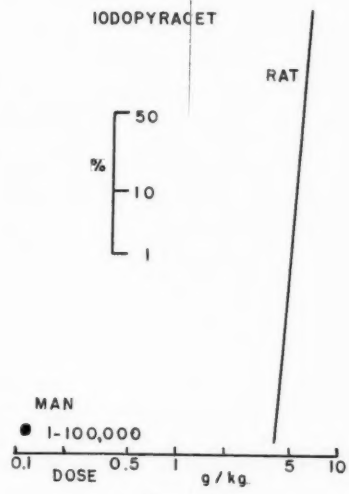

Figure 1

diagnostic agents is about the same in rat, rabbit, cat, and dog (1).

The second possibility is that the characteristic curve for toxicity in man is less steep than for the rat. That is, there is a wider individual variation among the members of the population, so that there are some individuals with a quantitative idiosyncrasy in that they respond in a manner in which all individuals would respond if given enough, but do so at a small dose. It seems likely that this is true.

The third possibility is that the individuals who die have a qualitative idiosyncrasy; that is, they respond in a manner that is different from the reaction that would be produced in all individuals if given enough, and that the production of this atypical response bears little relation to the dose. These are the characteristics of so-called "drug allergy," and there are reasons to believe that undesired reactions to these agents are of this nature.

There is, however, evidence against this

[1] From the Department of Pharmacology, University of Louisville School of Medicine, Louisville, Ky. Presented as part of a Symposium on Reactions to Intravenous Organic Iodide Compounds, at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17–22, 1957.

as a basis for all toxicity, presented by Sandström (3), chiefly that reactions may occur in persons not previously exposed to the agent. It also seems that the radiopaque diagnostic agents are not likely to function as haptens, which could lead to development of a sensitivity, as they are chemically not very reactive agents.

A remaining possibility is that of deiodination of the molecule in the body with a toxic reaction either to the iodine or to the remainder of the molecule. Although it is generally believed that this does not occur, recent investigations of substances related to thyroid hormone indicate the ability of the body to deiodinate substances, and suggest that this be re-examined.

In conclusion, it may be said that the nature of the toxic action of radiopaque diagnostic agents is not understood and requires investigation.

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SUMMARIO IN INTERLINGUA

Le Natura Del Action Toxic De Radio-Opac Agentes Diagnostic

Es a constatar que Iodopyracet produce un mortalitate de 1 in 100.000 in le dosage usual de 20 cm^3 de un solution de 35 pro cento, i.e. approximativemente 0,12 g per kg de peso corporee. Il es a supponer que un dose de 4 g per kg de peso corporee produceree le mesme resultato in rattos.

Iste constatation ha tres explicationes possibile. Le prime es que omne humanos es plus sensibile que rattos sed exhibi le mesme frequentias in le distribution del sensibilitate. Le factos argue contra iste possibilitate. Le secunde explication es que le curva characteristic del toxicitate in humanos es minus precipite que in rattos, i.e. que il ha un plus ample variation individual inter le membros del population. Isto pare probabile. Le tertie explication es que individuos in qui le responsa es mortal es distinguite per un idiosyncrasia qualitative e que lor responsa es pauco relationate al magnitude del dose. Isto pare explicar certe reactionesad verse sed illo non representa un explication satisfacente de omne formas de toxicitate.

Es suggerite un quarte explication. Secundo isto il se tractarea de disiodification del molecula in le corpore, con un reaction toxic al iodo o al resto del molecula.

De facto, le natura del action toxic de radio-opac agentes diagnostic es non ancora comprendite.

Reactions from Intravenous Organic Iodide Compounds: Pretesting and Prophylaxis[1]

NATHANIEL FINBY, M.D., JOHN A. EVANS, M.D., and ISRAEL STEINBERG, M.D.

PRETESTING AND prophylactic measures in contrast roentgenography are utilized to anticipate reactions and, in particular, to avoid fatality. For practical purposes, it is important to separate minor and major reactions to intravenous organic iodide compounds.

The *minor reactions*, such as urticaria, sneezing, arm pain, rhinitis, nausea, vomiting, and headache, are usually mild and transient, responding quickly to mere reassurance and symptomatic therapy. The frequency and intensity of the less serious reactions depend upon the condition of the patient, type of examination, the contrast medium, and the skill and experience of the physician. Many patients are ill and are naturally apprehensive about the examination. If the physician allows his own fears to become apparent or indicates by his questions that he is planning a dangerous examination, the patient responds by becoming reactive and ill at ease. If there is added an awkward or painful needle puncture, one may anticipate a large number of reactions. Thus, experience, skill, and a reassuring, optimistic demeanor are factors in prophylaxis.

The *major reactions* are less frequent and are probably related directly to the organic iodide compound. These serious reactions may be divided arbitrarily into three groups, each of which may result in a fatality.

1. *Sensitivity reactions*, such as angioneurotic edema or anaphylactic shock.

2. *Cardiopulmonary reactions*, which include hypotension, shock, apnea, pulmonary edema, syncope, and cardiac standstill.

3. *A miscellaneous* group which includes drug idiosyncrasy, fever, and convulsions.

Our efforts at prophylaxis are aimed at reducing the number and severity of these major reactions.

Before discussing specific measures of prophylaxis pertaining to pyelography, angiocardiography, venography, and cholangiography, it is well to remember that there are general prophylactic measures applicable to all intravenous injections. Surgically clean needles and syringes and uncontaminated solutions are important. Adequate sterilization and injection with aseptic technic are essential, since reactions may be due to contaminants, pyrogens, or chemical variants. Sudden, severe reactions may also be due to coincident disease rather than to the intravenous injection. Recently, one of our patients died of a massive pulmonary embolus while being moved to the radiographic table. Had this occurred after injection, it might have been counted as a fatality due to the contrast medium. Many similar instances are recorded in the literature.

If the serious reactor patients could be identified prior to injection, the dangers of the examination could be minimized. With this in view, search for a method of pretesting has continued for many years. There is still, however, no satisfactory way of pretesting which will allow the prediction of a severe or fatal reaction. The intraoral, skin, eye, and patch tests have proved unsatisfactory. Their use has resulted in undue confidence; death has occurred following a negative test, and important examinations have been unnecessarily cancelled when the test has been positive. Often, pretesting is done merely to satisfy a hypothetical medicolegal need. This is not justified since we feel that the patient's welfare is not jeopardized if pretesting is omitted.

The only practical method of pretesting

[1] From the Department of Radiology, The New York Hospital-Cornell Medical Center, New York, N. Y. Presented as part of a Symposium on Reactions to Intravenous Organic Iodide Compounds at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17–22, 1957.

which may have some value is the intravenous test. After intravenous insertion of the needle, a small amount of contrast material (usually 1.0 c.c.) is injected slowly. The patient is carefully observed for another minute for evidence of reaction. If there is no serious immediate reaction, the injection is completed. Although we are not convinced of the efficacy of the intravenous test and *do not use it routinely*, we recognize that it may have merit in the greater risk patient, in whom it might permit earlier detection of a serious reaction. It should be emphasized that even the small intravenous test dose has caused serious reactions and fatality.

Many diagnostic intravenous studies are performed in private offices. These office procedures are of practical importance and are of little hazard to the patient if the physician exercises sound clinical judgment by refusing office examination to those patients who, by history or clinical examination, are considered likely to suffer major reactions. The history is of prime importance and will readily exclude from office examination any patient who has had a previous severe reaction to an intravenous organic iodide. Medical judgment will defer patients seriously ill with allergic, renal, hepatic, or cardiac disease for hospital study, under optimal conditions, preferably where emergency measures are available. The contents of the emergency kit for special examinations in our radiology department are as follows:

For Respiratory Reactions
- Oxygen
- Airway tubes
- Hudson type mask and bag (for artificial respiration)

For Cardiac Reactions
- Wedge rib retractor and scalpel for cardiac massage
- Cut-down tray

Intravenous Medication
- 5 per cent dextrose
- Hydrocortisone
- Benadryl
- Neo-Synephrine
- Levophed
- Epinephrine 1:1000
- Seconal Sodium

Whenever contrast media are given intravenously, it is imperative that the attendant physician anticipate, recognize, and treat untoward reactions. A large quantity of equipment is not necessary in smaller radiographic installations, and the contents of the emergency kit should conform to the experience and clinical judgment of the attending physician.

If anesthesia is contemplated, especially in angiocardiography, the risks of the examination are enhanced. The anesthetic and the contrast medium may each contribute to serious reactions and fatality. Therefore, hospitalization and the presence of an experienced anesthetist during induction and recovery are mandatory.

Allergic, renal, hepatic, and cardiac disease are not contraindications to intravenous organic iodide injection. In our experience, serious reactions are not more common in these patients than in others. Similarly, it is well to explode the myth that a previous injection sensitizes a patient. Tolerance of an injection, even when minor reactions have occurred, is reassuring rather than suggestive of induced hypersensitivity. We do not hesitate to give a necessary second injection even of large amounts of concentrated solutions for angiocardiography or nephrotomography if the patient has had minor reactions such as flushing, urticaria, nausea, or arm pain. Indeed, our experience has shown that the second injection is usually better tolerated, probably because of reassurance.

Many premedications have been advocated for the prevention of serious reactions. Although a mild sedative may help in alleviating apprehension, we have found no medicament to be consistently preventive of major reactions. Antihistamines, orally or intravenously, have not been successful. Furthermore, the addition of any intravenous agent, especially when mixed with the contrast medium, adds still another source of reaction. In our experience, the antihistamines are useful for therapy but not for prophylaxis.

Variations in the speed of injection, the

position of the patient, and the temperature of the solutions have not resulted in greater safety. In fact, maximum speed of injection and the upright position are desirable for angiocardiography. Repeated examinations may be performed after a short interval, providing the indications are clear and sound clinical judgment has been exercised. A second injection should not be made immediately after a major reaction. Repeated injection is attended by greater risk in patients who are seriously ill with cyanotic heart disease or cardiac arrhythmia.

It is our conviction that good clinical judgment and the presence of a physician are important factors in the prophylaxis and treatment of severe reactions. The injection should be made under the supervision of an experienced physician, who has personally evaluated the patient and his history. When severe reactions occur, they usually begin within fifteen minutes after the completion of the injection. It is essential that the patient remain under constant observation during this period. Life-saving opportunities may be lost unless severe reactions are immediately detected and promptly treated.

Happily, in our experience, severe reactions and fatalities have been rare (Table I). Only 2 deaths have occurred in more than 70,000 intravenous pyelographic studies, and none within the past ten years. Both fatalities were in elderly men, seriously ill. Nevertheless, we are aware that major reactions and fatalities may occur despite all prophylactic efforts. The small risk is inherent in the intravenous injection of the available organic iodide compounds. Search for the ideal nonreactive intravenous radiopaque medium must continue.

TABLE I: FATALITIES IN INTRAVENOUS RADIOGRAPHY, THE NEW YORK HOSPITAL, TO NOV. 1, 1957

Examination	Patients	Deaths
Intravenous pyelography	70,930	2
Angiocardiography	3,550	1
Nephrotomography	350	0
Intravenous Cholangiography	1,250	0

In summary, the most valuable prophylactic measures may be listed as follows:

1. Good clinical judgment based on experience is of prime importance. This will detect the high-risk patient who requires hospitalization and special facilities.
2. Pretesting is of no proved value. However, the intravenous test is simple to perform and may be helpful. When in doubt, use it!
3. Antihistamines should be reserved for therapy and should not be used for the prophylaxis of serious reactions.
4. Preparation to recognize and treat reactions *immediately* is essential. Do not leave the patient alone during the critical fifteen minute postinjection period. A safety kit for emergency therapy should be available.

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SUMMARIO IN INTERLINGUA

Reactiones Ab Injectiones Intravenose De Organic Compositos Iodic; Pre-Essayage E Prophylaxe

Le reactiones minor provocate per injectiones intravenose de organic compositos iodic, effectuate con objectivos diagnostic, include urticaria, sternutation, dolores bracial, rhinitis, nausea, vomito, e mal de capite. Factores de efficacia prophylactic in iste gruppo de reactiones es le experientia, le habilitate, e un incoragiante comportamento optimistic del medico.

Le reactiones major es de tres typos, e cata un de illos pote provar se mortal. Illos es (1) le reactiones de sensibilitate, (2) le reactiones cardiopulmonar, e (3) un gruppo miscellanee de reactiones que include idiosyncrasia drogal, febre, e convulsiones. Pro evitar istos, un bon judicamento clinic basate super le experientia practic es del prime importantia. Assi

se detege le patientes qui representa un "alte risco," qui suffre seriemente de morbos allergic, renal, hepatic, o cardiac, e qui require hospitalisation e facilitates special.

Le pre-essayage pro sensibilitate drogal es sin valor demonstrate, sed le test intravenose es simple e pote esser de adjuta in casos de incertitude.

Antihistaminas debe esser reservate al uso therapeutic. Illos non debe esser usate pro objectivos prophylactic.

Esser preparate a recognoscer e tractar le reactiones immediatemente es essential. Le majoritate del reactiones occurre intra dece-cinque minutas post le injection, e le patiente non debe esser lassate sol durante iste periodo critic. Un necessaire de urgentia debe esser a mano pro objectivos de therapia.

Reactions Following Excretory Pyelography in Infants and Children[1]

LAWRENCE A. DAVIS, M.D.

Excretory pyelography is being performed with increasing frequency in infants and children. Not only is this study essential in the detection of congenital malformations of the genitourinary tract, but it is a helpful adjunct in the analysis of intra-abdominal tumors.

While many pyelograms are being obtained in the very early months of life, little has been reported concerning the dangers of the examination and the reaction rate in this special age group. In a recent analysis of deaths following excretory pyelography by Pendergrass *et al.* (1) one of the 25 reported deaths was in a two-and-one-half-year-old child. However, no breakdown as to age distribution in his entire series is available.[2] There has been some hesitancy in administering radiopaque media in sufficient doses in these young patients for fear of incurring serious reactions.

McClure (2) recently analyzed the reactions in 210 patients in the pediatric age group receiving adequate doses of Hypaque. Only 8 mild reactions were noted, all in patients over six years of age. This paper will analyze the reactions associated with excretory pyelography in 300 infants and children examined consecutively. (Separate injections in the same child are considered as individual cases.)

METHODS AND MATERIALS

In all of the patients the medium was injected intravenously. The greater number of the injections were performed by members of the Radiology Department and the children were carefully followed during the post-injection period. Urokon Sodium (50 and 70 per cent) was used 241 times and Hypaque (50 per cent) 59 times.

TABLE I: REACTIONS TO EXCRETORY PYELOGRAPHY IN 300 INFANTS AND CHILDREN

Cases 300	Reactions 31
Medium Urokon, 241 Hypaque, 59	Type of reaction Skin, 6 Gastrointestinal, 18 Skin and gastrointestinal, 3 Venospasm, 4

Doses were generous, ranging from 5 c.c. of the 70 per cent Urokon to 20 c.c. of the 50 per cent Hypaque. No rigid schedule was followed, but the dosage rate was roughly equated to the patient's age and weight. No pretesting for sensitivity was done in any of the cases; serum nonprotein nitrogen determinations were not purposely obtained prior to the examination. The rate of administration varied but for the most part was quite rapid.

ANALYSIS OF RESULTS

Comparison with reported adult series is impossible, since in the infants and younger children only such objective findings as vomiting, cardiovascular reactions, neurological abnormalities, and skin reactions can be considered. The subjective findings of nausea, unpleasant taste, and pain secondary to venous spasm cannot be evaluated. The reactions can actually be divided into two groups, objective and subjective, the latter analyzed only in the older age group. Because of this fact, the recorded reaction rate in infants may be much lower numerically than in adult groups.

In the 300 cases there were 31 reactions (Table I), none of which was serious enough to warrant discontinuance of the examination. Of the 21 gastrointestinal reactions, 6 were complaints of nausea obtained from

[1] From the Department of Radiology, University of Louisville Medical School, and the Children's Hospital, Louisville, Ky. Presented as part of a Symposium on Reactions to Intravenous Organic Iodide Compounds at the Forty-Third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17–22, 1957.

[2] See, however, Table IX, p. 9 of this issue of RADIOLOGY.

TABLE II: REACTIONS TO EXCRETORY PYELOGRAPHY: AGE DISTRIBUTION

Age	Cases	Reactions
0–12 months	60	5
0–30 months	115	6

older children. These, combined with 4 complaints of pain along the veins proximal to the injection site, give a total of 10 subjective complaints in the total of 31. The skin reactions were mild. Only one or two wheals were seen in most cases. Several such reactions may have been missed, since, at least on one occasion, the reaction did not appear until the patient had arrived home several hours following the injection.

Twenty per cent of the series were in the first year of life, but the low reaction rate in this group (Table II), as stated above, is not comparable with other reports.

No reactions occurred in those children showing nonfunction, either because of the naturally poor concentrating power during the first few days of life or because of disease.

CONCLUSIONS

1. Excretory pyelography with large, adequate doses of an opaque medium is a safe procedure in infants and children.
2. Reactions are few and of a mild nature.
3. Excretory pyelography should never be withheld solely because of the age factor.

ADDENDUM

Since the presentation of this paper, reactions have been analyzed in an additional 169 patients. Hypaque (50 per cent) was used in all. There were 18 gastrointestinal reactions and 1 skin reaction. None of these was severe.

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SUMMARIO IN INTERLINGUA

Reactiones Post Pyelographia Excretori In Patientes Pediatric

In un serie consecutive de 300 examines per pyelographia excretori, effectuate in infantes e juveniles per medio de Urokon a natrium e Hypaque in doses adequate, solmente 31 reactiones esseva observate. Nulle de istos esseva satis grave pro requirer le discontinuation del manovra. Iste observationes indica que iste typo de examine non deberea unquam esser omittite a causa del etate troppo juvene del patiente.

Reactions to Intravenous Organic Iodine Compounds and Their Immediate Treatment[1]

JOHN F. WEIGEN, M.D., and SYDNEY F. THOMAS, M.D.

YOU HAVE JUST completed the injection for an intravenous urogram and your patient is dying! You have a few minutes to reverse this process! You must be ready with the proper drugs and supportive measures and with a plan of action which is vigorous, yet controlled. These preparations must be made even though most patients suffering a reaction will recover without therapy, while some will die in spite of any treatment. You must plan for those who will recover with help but who will die without it.

The sequence of events in such a catastrophic response to the contrast medium is unknown. We are powerless to prevent the primary allergic reaction of the host to the foreign substance. We are equally unable to eliminate the products of this reaction, be they histamine or unidentified compounds. It is necessary, therefore, that oxygenated blood be kept circulating until homeostatic mechanisms are effective.

A dangerous reaction involves the cardiovascular, central nervous, or respiratory system, or a combination of these. It may occur without warning and become severe in a matter of seconds. In preparation for such an event you must have the appropriate medications at hand and have a plan of action for yourself, your technician, and available professional assistants. This team must be acquainted with the types of reaction to be anticipated and the methods of treatment, and each must know his role. The following is our plan of treatment, with specific drugs listed so that precise dosages can be stated. In practice these drugs and their dosages are to be selected by the individual who will use them.

CARDIOVASCULAR REACTIONS

"Cardiovascular collapse," the most common of the severe reactions following the intravenous injection of an iodine compound, requires immediate therapy before anoxia of the brain and heart proves fatal. The following measures are suggested at the first indication of a fall in blood pressure, to be modified by the severity of the reaction but to be continued until the pressure is maintained in a normal range:

Step 1:

(*a*) Remove all encumbrances, such as an abdominal compression band, etc.

(*b*) Give *oxygen*, with patient in 10- to 20-degrees head-down position. Make sure the airway is clear.

(*c*) Call for *assistance* by a prearranged signal.

(*d*) Record blood pressure at first practical opportunity.

Step 2:

Give *Aramine*, 2 to 3 mg. intravenously (0.2 to 0.3 c.c.). A jugular or femoral vein may be used if the antecubital veins are collapsed. If the needle used for the original injection is still within the vein, maintain it there, keep it patent with physiological saline in a large syringe with a rubber tubing adapter. This intravenous dose may be repeated after one minute if the blood pressure does not rise. It may be repeated and 2 to 10 mg. may be given intramuscularly (0.2 to 1.0 c.c.) if the pressure falls after rising.

Step 3:

(*a*) If the blood pressure is not sustained, give *Aramine*, 50 mg. in an intravenous infusion of 500 c.c.

[1] From the Department of Radiology, Palo Alto Medical Clinic, Palo Alto, Calif. Presented as part of a Symposium on Reactions to Intravenous Organic Iodine Compounds at the Forty-third Annual Meeting of the Radiological Society of North America, Chicago, Ill., Nov. 17–22, 1957.

of *physiological saline*, at a rate necessary to sustain systolic pressure at 90 to 120 mm. of mercury.

(*b*) If the blood pressure does not rise in one to five minutes following *Aramine*, give *Solu-cortef*, 100 mg. intravenously (2 c.c. Mix-o-vial).

Therapy is directed at overcoming hypotension with vasopressor drugs, but overmedication is to be avoided. Hypertension may be produced, possibly to be followed by "rebound" hypotension.

In spite of anything that may be done, cardiac arrest may ensue. Blows to the heart through the chest wall or a cardiac injection may restore its beat. Rocking the patient's knees against his chest at a rate of sixty times a minute is an additional maneuver worthy of trial (1). The rhythmical distention of the right atrium by the column of blood forced into it may initiate normal cardiac contractions. If these efforts fail, the physician is faced with the decision of whether or not to perform a thoracotomy and massage the heart. This decision must, in part, be made in advance, as the procedure requires surgical instruments, skilled help, positive pressure oxygen apparatus, and a plan for care of the patient should cardiac action be restored. Keeping in mind the difference between the usual arrest, such as may occur during surgery, and that resulting from anaphylactic shock, some may feel that maximal medical efforts would be of greater value than cardiac massage by a non-surgeon. If massage is performed, it should be instituted within a few minutes after the onset of cardiac arrest, before permanent brain damage occurs.

CENTRAL NERVOUS SYSTEM REACTIONS

Reactions characterized by convulsions are presumably the result of cerebral anoxia due to hypotension, but allergic cerebral edema or direct chemical irritation may at times be the cause. The convulsions must be stopped, not only because of the possibility of direct bodily injury, but because anoxia is increased by the associated apnea. The object of therapy is to restore the flow of oxygenated blood to the brain by measures already outlined. If convulsions continue after a normal blood pressure and adequate pulmonary ventilation have been established, a barbiturate should be administered. At the first indication of central nervous system stimulation, such as marked restlessness, twitching, or convulsions, action should be taken:

Step 1:

(*a*) Remove encumbrances.

(*b*) Give *oxygen*.

(*c*) Call for *assistance*.

(*d*) Record blood pressure at first practical opportunity.

Step 2:

Treat hypotension as outlined under "Cardiovascular Reactions."

Step 3:

If convulsions continue, give *Nembutal*, 25 mg. intravenously (0.5 c.c.), at two-minute intervals until they are controlled.

Usually only a little barbiturate is required. An amount that would be safe for a normal individual may cause serious respiratory depression in patients with circulatory collapse. If respirations are depressed, artificial respiration may be required, but respiratory stimulants should not be used, as these may, by themselves, produce convulsions under anoxic conditions. If respirations are markedly depressed by a barbiturate, serial blood-pressure determinations should be made, as circulatory depression may also occur.

RESPIRATORY REACTIONS

The final major category is that of respiratory reactions: bronchial asthma, laryngeal edema, or pulmonary edema.

An *asthmatic attack* severe enough to threaten life as a result of an intravenous injection usually occurs in a person with a previous history of asthma. With the beginning of an asthmatic attack the following is suggested:

Step 1:
Give *Adrenalin*, 0.3 to 1.0 c.c. of a 1/1000 aqueous solution subcutaneously.
Step 2:
If complete relief is not obtained, give *aminophylline*, 250 to 500 mg. intravenously (10 to 20 c.c.).
Step 3:
(*a*) Give *Benadryl*, 20 mg. intramuscularly (2 c.c.) if mild symptoms persist.
(*b*) Give *Solu-cortef*, 100 mg. intravenously (2 c.c. Mix-o-vial), if severe symptoms continue, or if status asthmaticus develops.

Laryngeal edema may occur alone or as part of a generalized urticaria. Should this happen, the following course of action is suggested:

Step 1:
(*a*) Give *oxygen* and call for *assistance*. Oxygen may be effective only if administered by positive pressure. If the required equipment is not available, the mouth-to-mouth method of artificial respiration may succeed. Manual methods may only aid expiration unless the obstruction to the airway is relieved. Adequate oxygen may be supplied temporarily by giving 100 per cent oxygen through a 15-gauge needle inserted between the tracheal rings.
(*b*) Give *Adrenalin*, 0.05 to 0.1 c.c. of a 1/1000 aqueous solution intravenously. (Caution! May produce ventricular fibrillation under anoxic conditions!)
(*c*) Give *Benadryl*, 10 mg. intravenously (1.0 c.c.).

Step 2:
If these measures fail, perform a tracheotomy, but only if Step 1 is unsuccessful after an adequate trial.

Pulmonary edema may be a part of an anaphylactic reaction and can be a terminal event. Under these circumstances, it may well be impossible to determine if the respiratory distress is the result of pulmonary edema due to acute cardiac failure or primarily an allergic response with pulmonary edema or even extreme bronchospasm. If what appears to be pulmonary edema should be the dominant process of a reaction, the following measures are suggested:

Step 1:
(*a*) Remove encumbrances.
(*b*) Give *oxygen* and call for *assistance*.
Step 2:
(*a*) Give *Adrenalin*, 0.05 to 0.1 c.c. of a 1/1000 aqueous solution intravenously. (Caution! May produce ventricular fibrillation under anoxic conditions!)
(*b*) Give *Demerol*, 50 mg. intravenously (1.0 c.c.).
(*c*) Give *Solu-cortef*, 100 mg. intravenously (2 c.c. Mix-o-vial).
Step 3:
Treat associated cardiovascular or central nervous system reactions.

MINOR REACTIONS

Minor reactions may take many forms and should be treated according to their severity. Most, such as venospasm, sneezing, nausea, flushing, and hyperventilation, require only reassurance. Urticaria may be observed or treated with an antihistamine intramuscularly or intravenously, depending upon the degree of associated pruritus. Periorbital edema or threatened laryngeal edema should be treated promptly with an antihistamine given intravenously.

ARMAMENTARIUM

The treatment of an individual reaction cannot be established categorically. Rather it is the physician's judgment that determines the method by which the reaction of a specific patient is treated. His preselection also determines the medications he has at hand. This will vary with his familiarity with individual drugs and the location of his office, *i.e.*, whether he is in an isolated office or located within a

large medical center. The following categories of drugs merit consideration:

(1) *Oxygen:* An adequate supply of oxygen should be close at hand and should be given for all major reactions. A positive-pressure apparatus is not essential but is more efficient than manual methods of artificial respiration. When oxygen is administered for respiratory obstruction, such as laryngeal edema, care must be taken that its use does not hide progressive obstruction. Under these circumstances, mechanical obstruction may progress unnoticed until cyanosis occurs in spite of oxygen administration. It may then be too late for additional treatment.

(2) *Vasopressors:* All vasopressors are sympathomimetic agents, many of which fulfill our requirements. The drug selected should be effective in raising the blood pressure yet unlikely to produce cardiac arrhythmia or central nervous system stimulation.

Metaraminol bitartrate (Aramine) is a potent vasopressor, one of a number that act quickly but have a prolonged duration of action. Therefore, it may be used by direct intravenous injection or diluted for slow intravenous infusion. Phenylephrine hydrochloride (Neo-Synephrine) is often used and is one of the vasopressors suitable for direct intravenous injection. Epinephrine and others with similar cardiac effect are less suitable for the treatment of shock because of the danger of inducing ventricular fibrillation. Levarterenol bitartrate (Levophed) is used by continuous intravenous infusion to maintain an adequate blood pressure. Aramine used in this way, however, has the advantage that its vasopressor effect is more easily controlled and that it does not produce venous thrombosis.

Fig. 1. Emergency equipment for treatment of allergic reactions to intravenous organic iodine compounds. Dosage chart (Fig. 3) is seen on the cover.

(3) *Anticonvulsants:* An intermediate acting barbiturate is the drug of choice to control convulsions. Any barbiturate

which can be given intravenously may be used except the long-acting ones, such as barbital and phenobarbital. These are not of value because of the delay in onset of their depressant action. Nembutal Sodium and Seconal Sodium have the advantage that they are available in liquid form for immediate injection. Most other short- or intermediate-acting barbiturates must be dissolved, thus delaying therapy.

Calcium gluconate has no effect upon convulsions occurring as the result of anoxia and is mentioned only to indicate its lack of value in the treatment of allergic reactions.

(4) *Anti-Allergic Drugs: Epinephrine* is the primary anti-allergic drug. It is used principally for acute asthma because of its ability to counteract the effects of histamine on bronchial muscles. It is also effective for relief of urticaria and angioneurotic edema but has been largely supplanted by the antihistamines in these instances. Epinephrine is preferred over ephedrine because it is more potent and acts more quickly.

Antihistamines presumably prevent the access of histamine to its receptor site in the cell, thereby blocking the response. Their most effective use, therefore, is prophylactic, and they have relatively little application in a sudden severe reaction requiring immediate reversal of hypotension or cessation of convulsions. They are effective, however, against urticaria or angioneurotic edema.

Fig. 2. Detailed view of box containing drugs and accessories. Note separate compartments for drugs used for cardiovascular reactions, central nervous system reactions, and for pulmonary reactions.

Antihistamines are available in many forms for intravenous administration, with varying degrees of antihistamine activity and sedative effect. Diphenhydramine hydrochloride (Benadryl) and promethazine hydrochloride (Phenergan) are potent antihistamines but are also the most sedative. Chlorprophenpyridamine maleate (Chlor-Trimeton) is less active in each respect, an advantage in instances of urticaria, hay fever, and other minor reactions. Any of these may be used as a prophylactic agent.

TYPE OF REACTION	DRUG		DOSAGE (AVERAGE ADULT)	
"CARDIOVASCULAR COLLAPSE"	ARAMINE$_R$	I.V.	0.2-0.3 cc.	(2-3 mgms)
		I.M.	0.2-1.0 cc.	(2-10 mgms)
		I.V.	5 cc. in 500 cc. SALINE	(50 mgms)
CONVULSIONS	NEMBUTAL$_R$	I.V.	0.5 cc. q. 2 MINUTES	(25 mgms)
BRONCHIAL ASTHMA	ADRENALIN$_R$	S.C.	0.3 cc. 1/1000 AQUEOUS	
	AMINOPHYLLINE	I.V.	10 cc.	(250 mgms)
	BENADRYL$_R$	I.M.	2 cc.	(20 mgms)
STATUS ASTHMATICUS	SOLU-CORTEF$_R$ (IN ADDITION TO ABOVE)	I.V.	2 cc.	(100 mgms)
LARYNGEAL EDEMA	ADRENALIN$_R$	I.V.	0.05-0.1 cc. 1/1000 AQUEOUS	
	BENADRYL$_R$	I.V.	1 cc.	(10 mgms)
PULMONARY EDEMA	ADRENALIN$_R$	I.V.	0.1 cc. 1/1000 AQUEOUS	
	DEMEROL$_R$	I.V.	1.0 cc.	(50 mgms)
	SOLU-CORTEF$_R$	I.V.	2 cc.	(100 mgms)

Fig. 3. Drugs and dosages for the treatment of acute reactions to intravenous organic iodine compounds. This chart is prominently displayed on the cover of the emergency kit in an effort to avoid errors in dosages which might occur under the stress which prevails during a reaction.

Adrenocortical steroids presumably do not interfere with the antibody-antigen reaction but instead block the tissue response to injury. The principal function of the adrenocortical hormones appears to be that of supporting rather than initiating actions of the regulating systems, a specific example of which is their ability to enhance the effect of vasopressor drugs. For this reason, adrenocortical hormones should not be used in place of standard methods for combating shock and may show no beneficial effect unless vasopressors are also employed.

The intravenous injection of hydrocortisone is the only method of administering adrenocortical steroids that fulfills our emergency needs. Solu-Cortef is available in a vial (Mix-o-vial) which allows mixing within the container for immediate injection.

(5) *Respiratory Stimulants:* Respiratory stimulants have no place in the armamentarium for combating respiratory depression, as any one of them is likely to produce convulsions under the conditions which prevail in allergic reactions.

(6) *Accessory Equipment:* Accessory equipment will include various articles according to the individual's desire.

Our emergency equipment (Figs. 1 and 2) includes the following:

1. Oxygen tank and mask, pharyngeal airways
2. Aramine, 1.0-c.c. ampule (10 mg.); 10-c.c. ampule (100 mg.)
3. Adrenalin chloride, 1/1000 aqueous, 1.0-c.c. ampule
4. Aminophylline, 10-c.c. ampule (25 mg./c.c.)
5. Benadryl, 10-c.c. ampule (10 mg./c.c.)
6. Solu-Cortef, 100 mg. (2 c.c. Mix-o-vial)
7. Nembutal sodium, 5-c.c. ampule (25 mg./c.c.)
8. Aromatic ammonia, crushable vial
9. Amyl nitrite, crushable vial
10. Demerol, 2-c.c. ampule (50 mg./c.c.)
11. Syringes: Tuberculin, 2, 5, and 20 c.c.; 1-inch needles, various sizes; 4-inch needle, No. 20
12. Rubber tubing adapter
13. 30 c.c. physiological saline
14. 500 c.c. physiological saline and venoclysis set

15. Sphygmomanometer and stethoscope
16. Padded tongue depressor
17. Instruction card (Fig. 3)
18. Suture kit, including scalpel
19. Tourniquet

SUMMARY

Treat the conditions threatening life, such as shock, convulsions, and bronchospasm, with specific counteracting drugs. Supplement this by combating the underlying allergic process with antihistamines and adrenocortical hormones.

Make your preparations simple. A few drugs that can be used effectively are better than a pharmacy. Make full use of any help that may be available, whether it is the extra pair of hands of your technician or an organized medical team.

Most important of all, prepare today for what may happen tomorrow. Tomorrow will be too late!

Acknowledgment: The authors are grateful to Marcus A. Krupp, M.D., Cutting B. Favour, M.D., John W. Pender, M.D., and Windsor C. Cutting, M.D., for their advice and criticism.

Palo Alto Medical Clinic
Palo Alto, Calif.

REFERENCE

1. STOUT, H. A.: Cardiac Arrest: Massage Without Incision. J. Oklahoma M.A. **50:** 112–114, March 1957.

SUMMARIO IN INTERLINGUA

Reactiones Al Injection Intravenose De Organic Compositos Iodic E Lor Tractamento Immediate

Un reaction periculose que occurre post le injection intravenose de compositos de iodo es un que interessa le systema cardiovascular, le systema nervose central, le systema respiratori, o un combination de iste systemas. Illo pote declarar se sin advertentia e attinger grados sever intra alicun secundas. Pro esser preparate a tal eventualitates on debe haber a mano le appropriate medicationes e etiam un plano de action pro se mesme, le technico, e le disponibile assistentes professional. Le plano de tractamento usate per le autores es delineate. Le specific drogas usate e lor precise dosages es mentionate.

Le directivas a obedir pote esser summarisate sequentemente: Tractar conditiones que impericula le vita del patiente—i.e. convulsiones, bronchospasmo, etc.—per medio de specific drogas contraactive. Supplementar istos per combatter le subjacente processo allergic con antihistaminas e hormones adrenocortical. Insister que le preparativas remane simple. Un numero restringite de drogas que pote esser usate efficacemente es melior que un pharmacia complete. Usar plenmente omne adjuta disponibile—sia le par additional de manos del assistente o sia un organisate equipa medical. E—plus importante que omne le resto—preparar hodie pro lo que pote occurrer deman.

Observations on Massive Osteolysis

A Review of the Literature and Report of a Case[1]

PHILIP M. JOHNSON, M.D.[2] and JAMES G. McCLURE, M.D.[3]

OSTEOLYSIS, OR dissolution of bone, is a nonspecific and relatively common abnormality produced by any decalcifying process of magnitude sufficient to diminish or destroy the roentgenographic image of a bone. A host of diseases may cause osteolysis; the commoner of these are infection, tumor, trauma (Sudeck's atrophy), various diseases of the nervous system, gout, the reticuloses, and scleroderma. The term "massive osteolysis" has recently been introduced to identify a rare and specific type of bone dissolution, associated with a benign, noncystic osseous angiomatosis and characterized by a progressive localized resorption of bone. For over a century scattered case reports have described patients with "phantom bone," "vanishing bone," "cryptogenic osteolysis," "spontaneous resorption of bone," "disappearing bone," "essential osteolysis," and the like. These names are now recognized as synonyms for massive osteolysis.

In 1954, one hundred and sixteen years after publication of the initial case of the disease, Gorham (10, 11) established massive osteolysis as a distinct clinical syndrome, and "Gorham's disease" has been proposed as an eponym for massive osteolysis (6, 13). One year later, Gorham and Stout showed that the pathological basis of the syndrome was an angiomatosis of bone (12). The purpose of this paper is to summarize current knowledge of this disease and to report the twelfth case of massive osteolysis associated histologically with an osseous angioma.

Gorham and Stout included in their paper summaries of 24 cases of massive osteolysis. To these there may now be added 7 cases. Three of these are histologically proved to have been associated with an osseous angioma, namely those of Phemister (27),[4] Gambier (8), and Hambach *et al.* (see page 43 of this issue of RADIOLOGY). The 4 remaining cases, typical clinically and radiologically but not proved, were reported by Henderson (14), Codet and Deluen (3), Milner (22, 23), and de Sèze and Hubault (4). With the example reported here (see Appendix) the number of cases on record is brought to 32, of which 12 have been established histologically. It is likely that the number will grow more rapidly as familiarity with this unusual disease is gained.

CLINICAL FINDINGS

Massive osteolysis is a rare chronic disease which begins insidiously and is characterized by a progressive regional loss of bone with resultant deformity. After a variable period of activity, it usually undergoes spontaneous arrest. Two cases, however, have terminated fatally after unremitting progression.

The earliest reported case, attributed to Jackson (16), appeared in *The Boston Medical & Surgical Journal* in 1838, with a late follow-up in the same journal in 1872 (17). Since this case epitomizes many features of the disease, and is of historical significance, it is abstracted here:

An 18-year-old boy fractured his right humerus three times within two months. Nonunion resulted, and thereafter each portion of the divided humerus

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[4] Slides of this case, diagnosed originally as lymphohemangioma of the bone, were loaned to us by Dr. C. Howard Hatcher and reviewed for us by Dr. Arthur Purdy Stout. Dr. Stout's diagnosis was osseous hemangioma producing massive osteolysis (30).

"began to diminish in size and shorten in length." The skin was intact and there was no sign of infection. Eventually only the ends of the humerus were palpable. At the age of thirty-six, the right upper extremity consisted of an essentially normal right forearm suspended from the shoulder by a pliant boneless cord of skin and atrophic muscle. There was no further progression; death at the age of seventy was due to unrelated causes.

Postmortem dissection disclosed that "all trace of the humerus is obliterated except its two extremities. The intervening space is occupied by a fibromuscular mass." The specimen was preserved in the Warren Museum of Harvard Medical School. Many years later, according to Thoma (31), roentgenograms of the specimen by Sosman demonstrated three thin bony spicules remaining at the site of the vanished humerus. (This is the only case discovered before the advent of the roentgen ray.)

The age at onset ranges from five to fifty-eight years, but the great majority of patients are children or young adults. There is no evidence of genetic transmission or sex predilection. There are no stigmata of systemic or endocrine disease, and no disturbances of calcium-phosphorus metabolism have been discovered. Transient elevations of serum alkaline phosphatase may occasionally occur under certain conditions (see below).

The presenting symptom of massive osteolysis is localized pain, usually secondary to pathological fracture, but deformity may be the only complaint. Palpation of the diseased area demonstrates a discontinuity or absence of bone and a mobility of normally rigid structures. The overlying tissues and skin are normal, although localized swelling may be present at onset, or develop later. In only one patient has intracutaneous extension of a hemangioma occurred during the course of the disease (13).

The findings on general physical examination are not remarkable, except for localized tenderness, deformity, and muscular weakness secondary to the disease. If, as has been hypothesized, the angioma acts to produce an intraosseous vascular shunt, blood flow through it must be small, for no case has shown evidence of high-output cardiac failure.

Massive osteolysis may originate in virtually any osseous structure, but has not been reported in the calvarium or terminal phalanges. In Thoma's case (31) the mandible underwent total resorption and the facial bones partially disappeared. The disease is polyostotic in the sense that it usually involves multiple contiguous bones, but it does so without dissemination and without "skip areas." The case reported by Dupas *et al.* (5) apparently contradicts two of the above statements, for the initial roentgenogram showed osteolysis of a second metacarpal and loss of the outline of the distal half of the terminal phalanx of the ipsilateral index finger. The intervening phalanges were normal. After sympathectomy, the osteolysis progressed in the metacarpus and involved the second proximal phalanx. The distal half of the terminal phalanx, however, underwent remineralization, and the terminal phalanx then was entirely normal in appearance. Whatever the cause of the initial demineralization of the terminal phalanx, it is difficult to conceive that it was directly related to massive osteolysis.

The disease exhibits a propensity for involvement of the shoulder girdle and the pelvis. A typical pattern of massive osteolysis is resorption of the clavicle, scapula, and proximal part of the humerus; another is dissolution of the ilium, ischium, and ipsilateral wing of the sacrum.

The course is unpredictable. Relatively few of the 32 known patients have been followed through their lives, or have come to autopsy. Pain is usually dull and mild except after pathological fracture. Spontaneous arrest is to be expected after an indeterminate period, measured in years. With arrest, the disease appears to remain stabilized indefinitely. The disability resulting from skeletal deformity may be severe, bizarre, and in some cases incapacitating. There is no evidence that reossification occurs after spontaneous arrest, but it has been reported following radiation-induced arrest (19, 27).

By contrast, in 2 patients the disease progressed rapidly and relentlessly, terminating fatally less than two years after clinical onset (10, 13). Both of these

patients exhibited marked resorption of bone, conspicuous soft-tissue swelling and edema due to extraosseous extension of the angioma, and bloody pleural effusions apparently caused by growth of the angioma into the pleural space. In one patient, superimposed cellulitis of the edematous soft tissues contributed to death. Perhaps coincidentally, the shoulder girdle was the site of origin of the disease in each patient. In this form massive osteolysis behaves clinically as a malignant tumor, although it is indistinguishable histologically from the benign form that undergoes arrest.

PATHOLOGICAL FINDINGS

Intraosseous angiomas form a well recognized entity which generally has no clinical significance. These benign vascular tumors, predominantly hemangiomas but occasionally classified as lymphangiomas, usually produce no symptoms because they remain localized, do not completely replace bone, and do not penetrate cortex. Expansion of bone is occasionally seen, and rarely a vertebral hemangioma may thereby produce compression of the spinal cord. These angiomas are nearly always discovered fortuitously during radiographic examination or at autopsy. Topfer is stated to have found angiomas in the spines of 11.9 per cent of 2,154 cadavers (32), but this relatively high incidence has been questioned by Lichtenstein (21), who feels that many of Topfer's angiomas may have actually been intravertebral blood pools formed by venous stasis. (Why intravertebral stasis should occur is not explained.) According to Sherman (28), the majority of true osseous angiomas occur in teh spine and skull, while about one-fourth are found in the long bones and the remainder at other sites. Although these tumors are usually solitary, multiplicity is not unknown and, in a variant form (cystic angiomatosis of bone), angiomas are disseminated in osseous and often in soft tissues (18). Massive osteolysis represents an extraordinary form (or variant) of angiomatosis and shares only one important characteristic with "ordinary" angiomas, that is, the presence of a histologically benign proliferation of intraosseous endothelial channels.

After Gorham's publication of 2 cases of "disappearing bones," in which the syndrome was first identified and a causal relationship to angiomatosis was suggested, he and Stout were able to obtain the original histological sections of 6 previously published cases. The pathological findings in these 6 cases and in Gorham's 2 patients were sufficiently similar to permit characterization of a specific pathological pattern for massive osteolysis (12). This consists of (*a*) an abnormal, marked increase of intraosseous capillaries, forming a bone-replacing angioma capable of extending beyond bone into soft tissues; (*b*) an absence of osteoclasts in the areas of bone resorption; (*c*) fibrosis. The pattern varies quantitatively from case to case and may be complicated by swelling of endothelial cells resembling that seen in hemangioendothelioma.

The freely anastomosing networks of endothelium-lined channels are usually filled with red blood cells or coagulum; if they are empty of such material, the possibility that these channels form a lymphangioma rather than a hemangioma cannot be excluded. An example is the case reported by Bickel and Broders as a "primary lymphangioma of the ilium" (1). Gorham and Stout's review indicated that the lesion could equally well be a hemangioma. Roentgenograms of this case are contained in Golden's *Diagnostic Roentgenology* (9).

Another problem rests in the identification of osteoclasts. The pathological material in several cases reviewed by Stout had been interpreted initially as containing osteoclasts; he found, however, that osteoclasts were in fact absent. This discrepancy has been attributed to the difficulty of interpretation of multinucleated intraosseous cells by those who deal infrequently with bone sections (30).

At least two pathological stages are seen

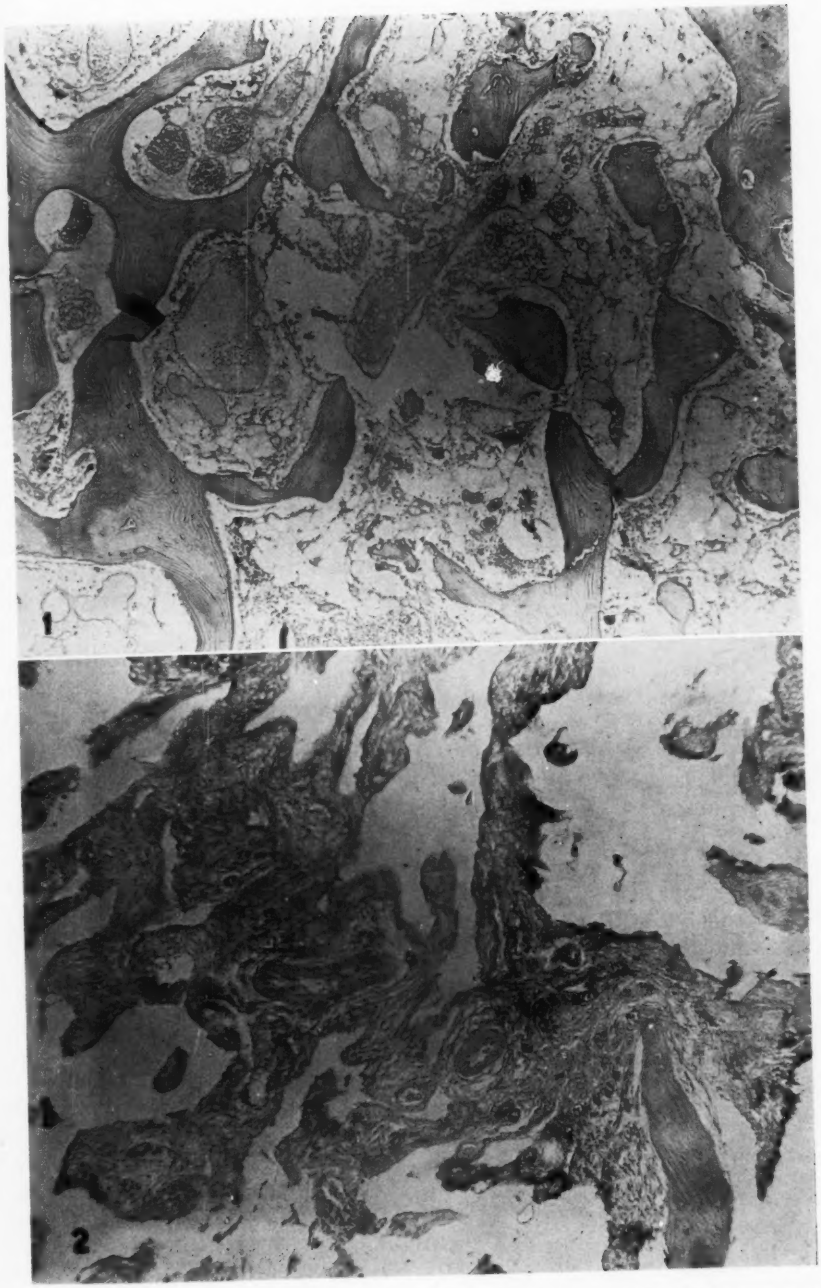

Fig. 1. Photomicrograph (×40) of the original biopsy specimen, showing the numerous thin-walled vascular channels which contain blood cells and ramify throughout the marrow spaces. (Reproduced, with permission, from photomicrograph of Accession No. 762181, Armed Forces Institute of Pathology.)

Fig. 2. Photomicrograph (×95) of another area of the original biopsy specimen. Note the thick-walled blood vessels. (Accession No. 762181, A.F.I.P.)

in massive osteolysis. Early in the disease there is an intraosseous capillary proliferation, similar to that seen distal to a congenital arteriovenous fistula (Fig. 1). Later, the angioma becomes predominantly fibrotic; however, complete avascularity is rare and calcification has not been observed (Fig. 4).

Inconstant intermediate variations may be noted. In our patient, for example, there were perivascular accumulations of lymphocytes and plasma cells (the latter forming Russell bodies) and prominent thickening of capillary walls (Fig. 2). In Phemister's patient (27), the infiltrating cells were predominantly eosinophils. An unusual pathological feature also demonstrated by our patient was the formation of a villous pattern (Fig. 3) at the sacroiliac articulation.

Grossly, massive osteolysis produces a bone which is softened, weak, and spongy in texture. On compression or incision the bone exudes bloody or serous fluid, and occasionally hemorrhage may be severe. The size and vascularity of the soft-tissue component are variable; at times the extraosseous component is larger and more vascular than the intraosseous component. By means of extension through soft tissue after having erupted from its bone origin, the angioma, unless arrested, eventually impinges upon other bones, which then in turn undergo partial or total resorption.

MECHANISM OF THE DISEASE

Despite clarification of the pathology, the etiology and pathophysiology of massive osteolysis remain obscure. Leriche's (20) hypothesis that post-traumatic arterial hyperemia was responsible for bone resorption was rejected immediately by Mouchet (25) and later by Gorham (10). In most cases trauma has been relatively trivial and in some it has not occurred. As in many other diseases, so in massive osteolysis the role of trauma is to signal the presence of a pre-existing abnormality. Gorham has advanced several hypothetical mechanisms for bone resorption, in particular the possibility that the angioma acts as a vascular shunt, bringing arterial blood into contact with bone and producing an active hyperemia (11).

Stout has emphasized the absence of osteoclasts in massive osteolysis. The role of the osteoclast in bone resorption, and indeed the nature of the osteoclast itself, are controversial. Follis (7) has stated that both osteoclasts and osteoblasts will destroy bone. Many consider the osteoclast and osteoblast to represent the same cell in different functional states (2). It is noteworthy that "typical osteoclasts" were almost completely absent in osteolytic metastases studied by Milch and Changus (24), who concluded that the bone destruction by metastatic tumor was the result of "direct mechanical pressure exerted by the tumor cells," perhaps augmented by physicochemical changes. Thus the absence of osteoclasts in massive osteolysis need not imply that an esoteric mechanism of bone resorption is present.

The osteolysis may be due, then, simply to progressive growth of a flexible soft-tissue mass within a rigid encasement. If the angioma is in addition an arterial shunt, there may be significant arterial pulsation within it. This in turn would enhance the resorptive process in the same manner that a pulsating aortic aneurysm erodes bone. (The capillary thickening noted in our case and in some others may reflect an increased intraluminal blood pressure.)

To bring the matter out of the realm of speculation, future investigations should include: (*a*) arterial and venous catheterization studies of blood pressure, *p*H, and oxygen saturation, proximal and distal to the lesion; (*b*) the intravenous use of appropriate dyes or radioactive isotopes to determine the rapidity of blood flow through the angioma or the degree of stasis within; (*c*) histochemical examination of the angioma to determine acid and alkaline phosphatase levels; (*d*) determination of pressures within the angioma and adjacent bone marrow. This last is a technically feasible procedure which has so far found little

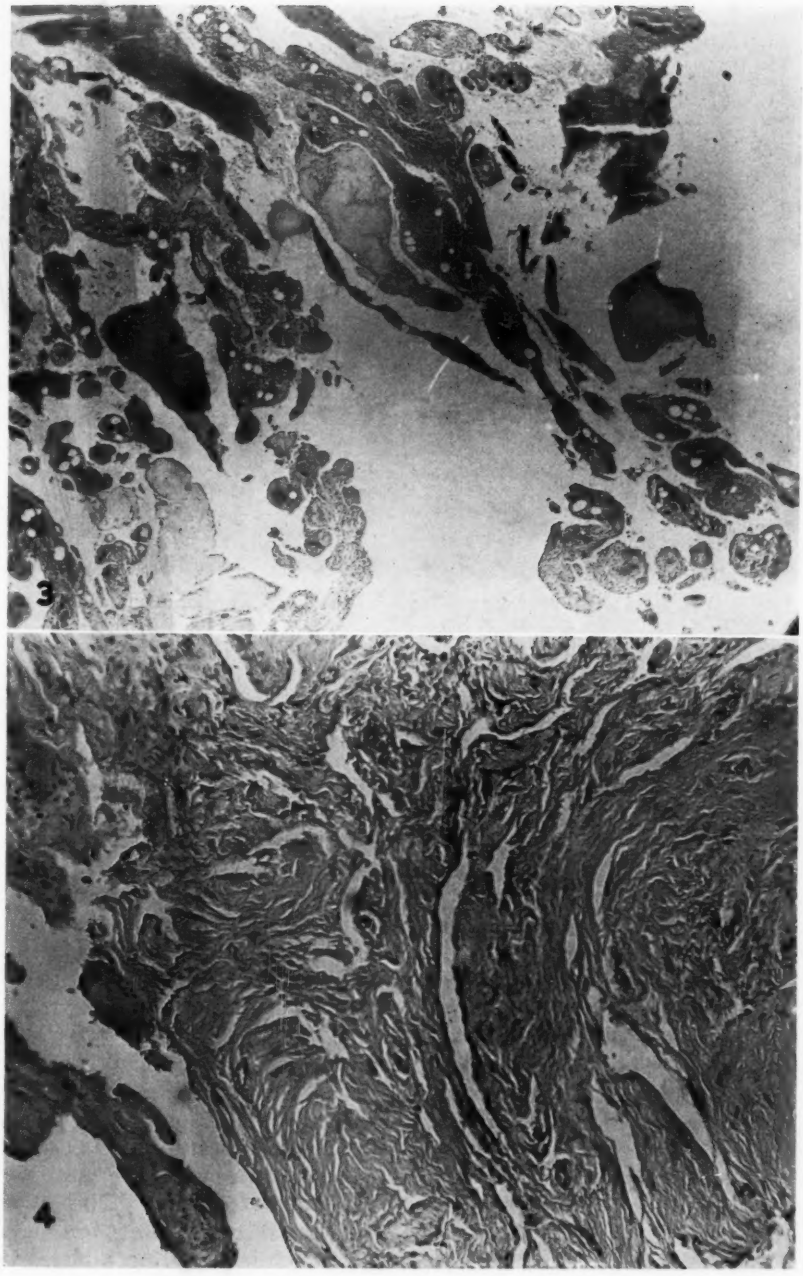

Fig. 3. Photomicrograph (×30) of the second biopsy specimen, obtained one year after onset. A rather striking "villus" pattern has developed. The vessels are surrounded by large numbers of plasma cells. (Accession No. 762181, A.F.I.P.)

Fig. 4. Photomicrograph (×100) of another area of the second biopsy specimen. The area is composed of dense fibrous tissue separating the endothelium-lined spaces.

Fig. 5. June 8, 1955, three weeks after onset. The left ischial body, superior ramus, and tuberosity contain numerous, occasionally well defined, radiolucent foci. Note the solitary focus which breaks the pelvic brim at the acetabular level.

Fig. 6. Sept. 3, 1955, three months after onset. Ischial biopsy and curettage have produced the large cortical and medullary defects at the junction of the inferior ischial ramus and tuberosity. Note increased, partially confluent osteolysis of superior ischial ramus, with disappearance of cortex laterally. A transverse fracture crosses the central acetabulum.

clinical application. Stein *et al.*, in a recent paper, discuss methodology and results obtained in animals (29).

Patients in whom the disease had undergone spontaneous or radiation-induced arrest would not, in our opinion, prove satisfactory for such investigations, which should be carried out in persons with active, progressing, untreated disease. With respect to the possibility that some cases of massive osteolysis are due to lymphangiomas and therefore are exempt from the above remarks, it may be pointed out that, of the 12 proved cases of the disease, only one (Bickel and Broders') *might* have been a pure lymphangioma.

ROENTGEN FINDINGS

The roentgenographic examination of patients with massive osteolysis yields striking, often unexpected findings which are initially quite nonspecific. A considerable difference exists between the roentgenographic appearance of the early, intraosseous stage and that seen following breakthrough and extraosseous extension of the angioma. In few of the reported cases are films shown demonstrating early massive osteolysis; we were fortunate in obtaining the original roentgenograms of our patient, depicting the disease in an early stage.

A. The Intraosseous (Uniphasic) Stage of Massive Osteolysis: The earliest detectable roentgenographic abnormality is the presence of one or several clustered intramedullary and subcortical radiolucent foci of varying size, representing areas of trabecular resorption. These usually lack distinct margins, but are occasionally partly outlined by incomplete, very thin, opaque edges (Fig. 5). Soon, as the disease progresses, these foci undergo enlargement and tend to coalesce, while new radiolucent foci appear at the periphery. With coalescence and growth,

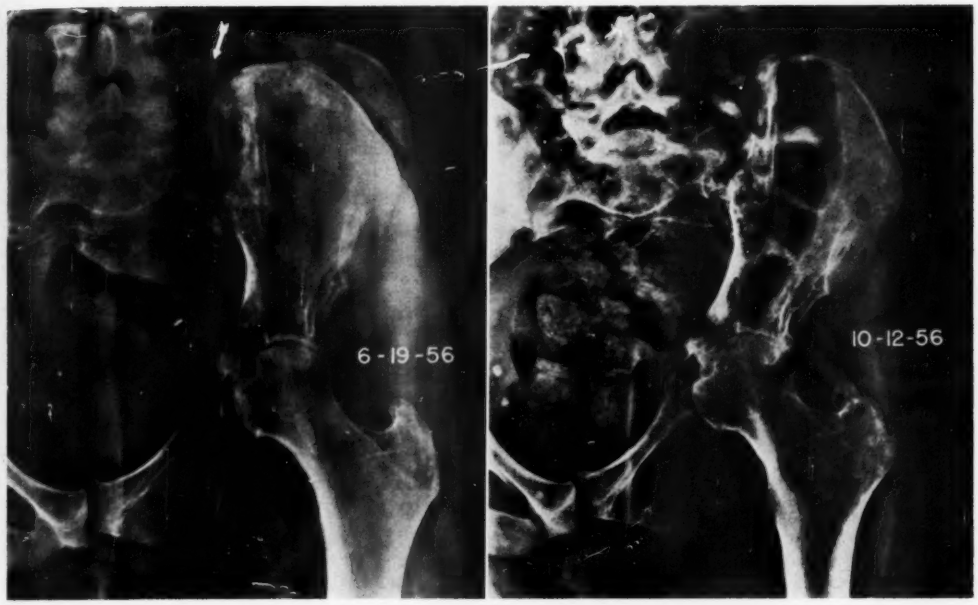

Fig. 7. June 19, 1956, one year after onset. The ischial tuberosity and inferior ischial ramus have disappeared. There is further osteolysis of the medial acetabular wall. Resorption is under way in the pubic rami, ilium, left wing of sacrum, and left 5th lumbar transverse process (arrow). Note subluxation of ilium and pubis, tapering of ischial remnant, and indistinctness of tip of greater trochanter.

Fig. 8. Oct. 12, 1956, sixteen months after onset; four months after biopsy of left sacrum and ilium; three months after first course of radiotherapy. Note irregular callus at site of acetabular fracture and tapering of ischial remnant and pubic ramus. The tip of the greater trochanter is flattened.

expansion of the medullary cavity occurs and the overlying cortex becomes attenuated. Eventually the cortex disappears locally, as a result either of continued resorption or of pathological fracture (Fig. 6).

Early in this stage massive osteolysis resembles a nondescript patchy "osteoporosis," but later its appearance becomes that of any expanding, nonsclerosing intramedullary lesion. The osteolysis is quite pure; there is no neoplastic osteogenesis or significant reactive bone formation.

B. The Extraosseous (Biphasic) Stage: Having produced a disruption in the cortex of the encasing bone, the angioma then invades and proliferates in the surrounding soft tissues. Bony resorption continues but is now caused by the extraosseous as well as by the intraosseous component of the angioma. The relative growth rates of these two components may not be identical. When intraosseous growth is the more rapid, medullary bone resorption predominates and a stage is reached in which the bone develops a "shelled-out" appearance due to relative preservation of most of the cortex.

However, a frequent finding in published roentgenograms, and noted also in our patient, is *tapering* of the still opaque portion of the bone (Fig. 7). This is most evident when a tubular bone is involved. Although tapering may perhaps be produced by gradual collapse of weakened bony walls which lack medullary support, an alternate hypothesis would seem to be as follows: There is progressive resorption of cortex by the extraosseous component of the angioma due to its pressure, augmented by growth and perhaps by pulsation. Simultaneously, a layer of cortical new bone is formed, preserving the cortical outline. The result is a roughly concentric shrinkage of shaft diameter until eventually the two cortical surfaces unite, blending into a single radiopaque shadow (Fig. 8).

Fig. 9. Feb. 7, 1957, twenty months after onset. Further subluxation of the left ilium is seen, with medial rotation. Callus at the acetabular fracture is denser but does not bridge the gap. Irregularity and sclerosis of the right os pubis are due to trauma resulting from abnormal mobility of the left pubis. The tip of the greater trochanter has now disappeared (arrow), but the cortex of the remaining portion is still intact (see text).

Total resorption may then follow, barring the event of spontaneous arrest. Support for this concept is found in the reaction undergone by intact bone which becomes resorbed from without as the angioma spreads extraosseously from its original site (see below). We believe that the presence of tapering is due to predominance of extraosseous resorption in the biphasic stage. It constitutes a useful diagnostic sign of massive osteolysis.

Massive osteolysis may remain confined to one bone, but will usually progress to involve multiple contiguous bones, although the one originally involved may not completely disappear. As a bone undergoes invasion from without, the cortex at the point of contact initially tends to remain intact, although later "giving way" and often disappearing as shrinkage occurs (Fig. 9). This relative preservation of cortex during the earlier stages of extraosseous resorption we take to indicate reactive new bone formation, as outlined in the preceding paragraph. The amount of new bone so formed is very small, and no associated rise in alkaline phosphatase can be detected.

The roentgenographic appearance becomes diagnostic of massive osteolysis when unilateral partial or total disappearance of contiguous bones, tapering of bony remnants, and absence of a sclerosing or osteoblastic reaction (apart from that described above) are present. Pertinent negative roentgenographic findings are absence of phleboliths, of vascular or soft tissue calcification, of coarse trabeculation (characteristic of most "ordinary" angiomas), and of any related bony abnormality with the exception of demineralization resulting from disuse.

In our patient, pathological fracture of the acetabulum was followed by the appearance of calcified callus (Fig. 9), but bony union did not occur. There was a concomitant transient rise of serum alkaline phosphatase.

C. Special Studies: Confirmation of the roentgen diagnosis of massive osteolysis can be achieved before biopsy by vascular opacification studies, first employed by Hambach (13). Both arteriography and phlebography may produce opacification of the angioma, but these methods are inferior to direct injection of the angioma or of the bone in which it lies. Using the method of direct opacification, Hambach produced in his patient a homogeneous and largely complete outline of a totally resorbed scapula. In our patient an attempt at indirect opacification by means of aortography was unsuccessful, but partial success was achieved by means of osseous angiography (Fig. 10, D). Our inability to produce opacification of all areas of bone resorption suggested that the channels had become obliterated in these areas, perhaps as a result of two courses of radiation therapy. We were able to demonstrate the extraosseous component in the one area where active bone resorption was continuing.

To produce the greatest information, any opacification study should be carried out with serialographic equipment; we used a Schönander uniplane camera.

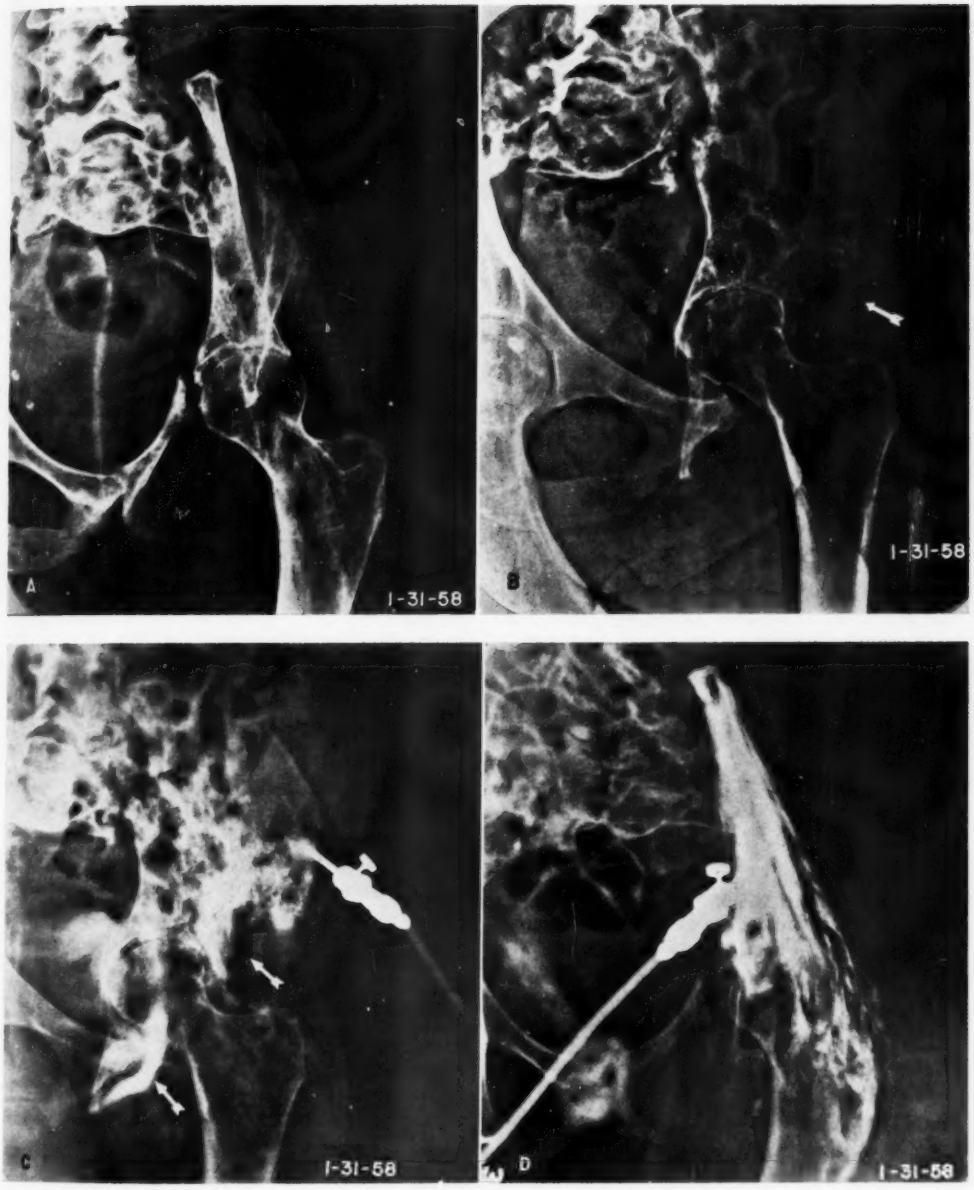

Fig. 10. Jan. 31, 1958, thirty-one months after onset; eight months after second course of radiotherapy.
A. Little interval change has occurred save for slight further resorption of the greater trochanter. Medial rotation of the left ilium has increased. The acetabular fracture persists.
B. An oblique roentgenogram shows the left ilium *en face*. Note loss of bone below anterior superior spine (arrow). The changes at the inferior portion of the left sacroiliac articulation are more evident.
C. Single oblique roentgenogram made early during injection of contrast material into left ilium at the anterior superior spine. Lower arrow indicates contrast material in labial fold following attempted intrapubic injection. Upper arrow indicates extraosseous extension of contrast material.
D. One of the serial frontal roentgenograms made during osseous angiography. The ilium is homogeneously opacified but this appearance is due in part to the end-on view. Note streamers and tails of contrast material extending into the soft tissues about the femoral head and greater trochanter. No draining vessels were demonstrated on later films.

TREATMENT

The French surgeon Mouchet, who personally examined 2 patients with "disappearing bone," felt that no treatment was of value (26). This therapeutic nihilism did not, however, discourage others from attempts at cure by means of radiotherapy and surgery.

The surgical treatment of massive osteolysis has consisted of amputation and local resection, with and without replacement prostheses or bone grafts. At one time sympathectomy was advocated (20), and this operation was performed in one patient (5), without effect on the disease. Surgical removal of tissue involved by osseous angiomas has not been characterized by uniform or predictable success. In Jackman's case, resection of an involved third metacarpal from an otherwise normal-appearing hand was followed, one year later, by development of osteolysis in the fourth metacarpal (15). Apparently, not all of the soft-tissue component was resected. Gambier removed the remnant of an involved humerus and inserted a nonmetallic prosthesis which later itself underwent absorption (8). On the other hand, in Henderson's case resection with placement of bone grafts resulted in bony regeneration and union (14).

Results obtained with radiation therapy have also been equivocal, although in a few cases apparent arrest has been produced. King's patient, a twelve-year-old male whose ilium and femur were the site of osteolysis, received 1,700 r (air) at each of four paired opposing ports in thirty-eight days (kv 200, h.v.l. 1.05 mm. Cu, T.S.D. 50 cm.). In six months crural swelling had decreased; in one year roentgenograms showed moderate shrinkage of osteolytic areas, chiefly in the ilium (19). Gorham's second patient, a forty-four-year-old male with osteolysis of the shoulder girdle, received "a series of deep x-ray treatments" (10), after which no further progression was observed during a follow-up period of two years. Phemister reported partial reossification of lytic areas in the ilium and sacrum following radiation therapy of a nine-year-old child (27). No details of treatment were given. Following two courses of radiotherapy, our patient has exhibited arrest of disease except in one undertreated area. On the other hand, Bickel and Broders' patient, a five-year-old girl with iliac involvement, received no benefit from "seven light doses of radiation therapy administered at monthly intervals" (1). Further, Hambach states that in his case, which progressed to death, radiation therapy was without effect. Again, dosage, time, and treatment factors are not stated (13).

It is evident that no firm conclusion as to treatment can be drawn from these cases. The paucity of the material, the incomplete radiotherapy data in some reports, and the known tendency of massive osteolysis to undergo spontaneous arrest must temper enthusiasm for the use of radiation therapy. Nevertheless, the known ability of ionizing radiation to produce an obliterative endarteritis may explain the satisfactory result obtained in some cases. In our opinion there is an acceptable rationale for the use of ionizing radiation in massive osteolysis with the intent of producing arrest and, perhaps, partial reossification. Surgical intervention, apart from biopsy, appears to be best reserved for treatment of cases not responding to radiation therapy, and for correction of deformity following spontaneous or radiation-induced arrest.

SUMMARY

Massive osteolysis is a rare idiopathic disease associated histologically with a variant form of osseous angiomatosis. It possesses distinctive clinical, pathological, and roentgen features. Histologically benign, the disease destroys bone locally and is not confined by bony margins. In 2 cases it has progressed inexorably to death. Usually, however, massive osteolysis does not threaten life, but remains localized within a skeletal region and undergoes eventual spontaneous arrest. There are

no associated endocrine or metabolic disorders. The mechanism of bone destruction and resorption is unknown.

In its early stages the disease cannot be distinguished roentgenographically from localized, nonsclerosing osteolysis due to other causes. With its evolution, a roentgenologic diagnosis can be made on the basis of purely osteolytic destruction of multiple contiguous bones in a child or young adult. Confirmation of the diagnosis prior to biopsy may be obtained by methods which opacify the angioma, either directly or indirectly.

A certain amount of therapeutic success has followed radiation therapy in some cases, and bone graft surgery in one case, although in no instance has complete healing occurred. While the effectiveness of radiation therapy in massive osteolysis cannot yet be critically evaluated, the modality deserves thorough therapeutic trial in future cases of this disease. It is doubtful that extirpative surgery is applicable in massive osteolysis, although reconstructive surgery may be valuable in selected cases.

A total of 32 cases of massive osteolysis have been discovered; 12 have been histologically confirmed, including the case reported herein.

ACKNOWLEDGMENTS: Vhe authors extend their sincere thanks to the following persons whose efforts contributed to this paper: Charles A. Bream, M.D.; L. Whittington Gorham, M.D.; George D. Penick, M.D.; R. Beverly Raney, M.D.; Arthur Purdy Stout, M.D.; John Wooten, M.D.; Miss Dorothy Long.

APPENDIX: CASE HISTORY

M. E. S., a 29-year-old colored woman, was admitted to the Memorial Hospital of the University of North Carolina on June 18, 1956, complaining of a limp and left hip pain of one year duration.

Present Illness: One year before admission the patient had suddenly twisted her left leg. Immediate nonradiating left hip pain caused her to limp, and three weeks later she consulted an orthopedic surgeon,[5] who obtained a roentgenogram of the pelvis. This disclosed a destructive lesion of the left ischium (Fig. 5), and biopsy of this area was performed. The tissue, submitted to another teaching institution, was initially interpreted as "fibrochondroma"; on later review at the same institution a revised diagnosis of "aseptic necrosis of bone" was made.

The patient continued her usual activities, although limp and pain persisted. A roentgenogram nine months before admission (Fig. 6) showed progression of the destructive process. About one month before admission the severity of the left hip and gluteal pain increased.

The *past history* was noncontributory. The patient had had 9 pregnancies, with 2 abortions and 5 children living and well.

Family History: Of 5 siblings, 4 were dead of unknown causes. A sister, age 36, was living and well. The mother was dead; the condition of the father was unknown. The patient stated that no members of her family had had an illness resembling hers.

Physical Examination: Temperature 98.6°, pulse 60, respirations 20, blood pressure 110/80. The patient was slightly asthenic, well nourished, and in no distress, walking with a left limp. The skin was clear, without hemangiomas or edema. The general physical examination revealed no abnormality of the head, neck, eyes, nose, throat, chest, or abdomen. The heart was not enlarged, and there was no evidence of congestive failure. The condition of the peripheral pulses in the legs was not recorded. There was no neurological deficit.

The orthopedic examination revealed a left limp due to weakness of the gluteus medius and maximus and to one-half inch shortening of the left lower extremity. The Trendelenburg test was positive on the left. Left hip flexors were fair, abductors poor, hamstrings fair-plus, and gluteus maximus poor. On manual pressure, the left ilium was readily mobile and could be displaced toward the right ilium. Pressure over the left ischial tuberosity and sacrum produced mild tenderness. At the left hip, flexion and extension were fully preserved. There were 80 degrees of internal rotation, 50 degrees of external rotation, 20 degrees of abduction, and 50 degrees of adduction. There was no atrophy of thigh or calf.

Laboratory Examination: A serological test for syphilis was negative. Hemoglobin was 13.0 gm. per cent; white blood cell count 6,200, with 6 per cent metamyelocytes, 80 per cent polymorphonuclear leukocytes, 4 per cent eosinophils, and 10 per cent lymphocytes. Urinalysis was negative. Serum albumin was 4.0 gm. per cent and globulin 2.1 gm. per cent, serum calcium 10.9 mg. per cent, phosphorus 5.0 mg. per cent, and alkaline phosphatase 3.4 Bodansky units. The blood urea nitrogen was 10 mg. per cent, and the serum cholesterol 184 mg. per cent. Intradermal tests with blastomycin, coccidioidin, histoplasmin, and second strength PPD were negative at forty-eight hours. The blood was Type O, Rh negative. The circulation time was not determined.

Roentgenographic Studies: The destructive lesion

[5] Dr. John Wooten, Greenville, N. C.

in the left hemipelvis had progressed considerably since earlier roentgenograms (see Fig. 7 *et seq.*). Roentgen examination of the remainder of the skeleton, including the skull, and of the chest revealed no abnormality.

Course: Preoperatively, the diagnoses of metastatic carcinoma (primary site undetermined), osteolytic osteogenic sarcoma, and an angiomatous skeletal lesion were considered. On June 23, 1956, a biopsy of the left ilium and left wing of the sacrum adjacent to the sacroiliac articulation was performed. The bone at both sites was thin, with little strength. A moderate amount of watery, blood-tinged fluid exuded from the cut surface of the bone. There was no excessive bleeding; no blood pools were found.

The biopsy material was examined by Dr. George D. Penick, who noted thin trabeculae devoid of osteoclasts, areas of highly vascular fibrous tissue, and areas of extremely cellular tissue heavily infiltrated by plasma cells, lymphocytes, and numerous small thick-walled vessels. A diagnosis of massive osteolysis was made. The slides were reviewed by Dr. Lent Johnson (Armed Forces Institute of Pathology), by Dr. Arthur Purdy Stout, and by Dr. L. Whittington Gorham, all of whom confirmed the diagnosis of massive osteolysis. A review of the biopsy material obtained eleven months before admission disclosed evidence of an intraosseous hemangioma (see Figs. 1–4).

The wound healed *per primam*, and the postoperative course was uneventful. A course of external radiation therapy was decided upon, and a midline tissue dose of 1,420 r was delivered to the left hemipelvis and lower lumbar spine through two opposing ports in eighteen days (kv 220, ma 20, T.S.D. 50 cm., h.v.l. 1.09 mm. Cu). The left trochanteric area lay at the margin of the irradiated zone; as a result, the dose delivered to it was considerably less than 1,420 r.

Prior to discharge on July 19, 1956, a cast was applied from the lower thorax to the distal thigh in an attempt to obtain "tightening-up" of the left sacroiliac joint and thereby decrease the excessive mobility of the left ilium. The cast was worn for nearly three months, when it was permanently removed. Roentgenograms of the pelvis at that time revealed tapering of the inferior ramus of the pubis and subluxation of the pubis (Fig. 8).

When seen again, twenty months after onset, the patient complained of pain in the left sacroiliac region with attempted weight-bearing on the left lower extremity. Roentgenograms showed incomplete repair at the fracture site on the medial side of the acetabulum. There was further deformity due to rotation of the mobile left ilium, and early osteolysis of the left greater trochanter (Fig. 9). Another cast was applied as before.

Three months later the cast was removed and the patient was readmitted for abdominal aortography. This procedure failed to produce opacification of the angioma. Roentgenograms of the pelvis revealed no significant change. Laboratory studies showed a serum protein of 6.9 gm. per cent, calcium 9.8 mg. per cent, phosphorus 5.1 mg. per cent, and an alkaline phosphatase of 10.1 Bodansky units. The last determination, indicative of osteoblastic activity, suggested that a slight degree of reossification was occurring. During this admission the patient was subjected to a second course of radiation therapy, which delivered a midline tissue dose of 1,900 r to the left hemipelvis in sixteen days, with factors and port positions as before. Crutch walking, with no weight-bearing on the left lower extremity, was begun.

On Jan. 31, 1958, two and one-half years after onset of her disease, the patient remained able to walk on crutches but could not bear weight on the left lower extremity. She complained only of mild aching in the left buttock at the end of the day. The left lower extremity was 1 inch shorter than the right when measured from the anterior superior iliac spine to the medial malleolus. There had been slight further resorption of the left trochanteric tip (Figs. 10, A and B).

Under local analgesia osseous angiography was carried out. The initial attempt at opacification was unsuccessful, due to penetration of the tip of the bone marrow needle through the posterior cortex of the left superior pubic ramus. The needle was then inserted into the left anterior superior iliac spine and 40 c.c. of 50 per cent Hypaque was injected. Frontal and oblique roentgenograms were obtained by means of a Schönander serialographic camera. There was opacification of the left ilium and spread of the contrast material into the left gluteus medius and minimus muscles adjacent to the left femoral greater trochanter (Figs. 10, C and D). A total of 80 c.c. of Hypaque was used. About 35 c.c. was recovered by intraosseous aspiration at the end of the procedure.

The total protein at this time was 7.6 gm. per cent, calcium 9.8 mg. per cent, and phosphorus 5.0 mg. per cent. The alkaline phosphatase had fallen to 4.9 Bodansky units. Complete blood count and urinalysis were normal except for minimal albuminuria. The patient was advised to continue walking on crutches and to avoid weight-bearing on the left lower extremity.

A course of radiotherapy to the left trochanteric region is contemplated.

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SUMMARIO IN INTERLINGUA

Observationes Relative A Osteolyse Massive Revista Del Litteratura E Reporto De Un Caso

Osteolyse massive es un morbo idiopathic que es rar. Histologicamente illo es associate con un variante de angiomatosis ossee. Illo possede distincte aspectos clinic, pathologic, e roentgenographic. Benigne ab le puncto de vista histologic, le morbo destrue le osso localmente e non es confinate per margines ossee. In 2 casos illo progredeva inexorabilemente usque al morte del patiente. Tamen, usualmente osteolyse massive non menacia le vita sed remane localisate intra un region skeletic e se arresta spontaneemente in le curso del tempore. Il non ha ulle associate disordines endocrin o metabolic. Le mechanismo del destruction e del resorption de osso non es cognoscite.

In su stadios precoce le morbo non es distinguibile per medios roentgenographic ab localisate osteolyse non-sclerotisante de altere etiologias. In le curso de su evolution, un diagnose roentgenologic de illo

deveni possibile super le base del destruction purmente osteolytic de multiple ossos contigue in juveniles o juvene adultos. Le confirmation del diagnose ante le effectuation de un biopsia es possibile per medio de methodos que produce un opacification del angioma—directe- o indirectemente.

Un certe grado de successo therapeutic ha sequite le tractamento per irradiation in certe casos. In un caso, graffage ossee ha resultate in un simile successo. Sed resanation complete non ha occurrite in ulle caso cognoscite. Ben que il es non ancora possibile evalutar criticamente le efficacia del therapia a radiation in casos de osteolyse massive, le methodo merita le plus meticulose essayo therapeutic in casos futur de iste morbo. Il es dubitose que chirurgia extirpative es applicabile in osteolyse massive, sed chirurgia reconstructive es possibilemente de valor in casos seligite.

Un total de 32 casos de osteolyse massive ha essite discoperite. Dece-duo esseva histologicamente confirmate.

Massive Osteolysis Due to Hemangiomatosis

Report of a Case of Gorham's Disease with Autopsy[1]

RUDOLF [illegible]BACH, M.D., [illegible], and VLADIMÍR MALÝ, M.D.

MASSIVE OSTEOLYSIS (acute spontaneous absorption of bone, phantom bone, disappearing bone) is a rare disease, only a few cases having been described in detail. Nothing was definitely known as to its possible etiology until Gorham, Wright, Shultz and Maxon (1) reported the presence of an overgrowth of small thin-walled blood vessels (angiomatosis) in 2 cases and suggested that the resulting active hyperemia might disturb the balance between osteoblasts and osteoclasts, so that bone destruction exceeds bone production. Added weight was given to this theory in a later publication by Gorham and Stout (2), who described this same histologic picture in 8 cases previously published, the original biopsy slides having been submitted to them by various authors. From this study it was concluded that a hitherto unrecognized syndrome exists, characterized by a striking similarity in its clinical, roentgenographic, and histologic findings. However it is actually accomplished, the progressive osteolysis appears to be always associated with an angiomatosis of blood vessels, and sometimes of lymph channels, which seemingly is responsible for it.

The term hemangiomatosis was first applied by Stout (3) in 1944 to describe the proliferation of capillaries which he had observed in the soft tissues distal to [illegible] filariae. [illegible] ig (4) a [illegible] e osteoly [illegible]46.

The following case closely resembles the [illegible] rham and Stout, and is [illegible] sent only the second instance where autopsy was performed upon a patient with this unusual condition.

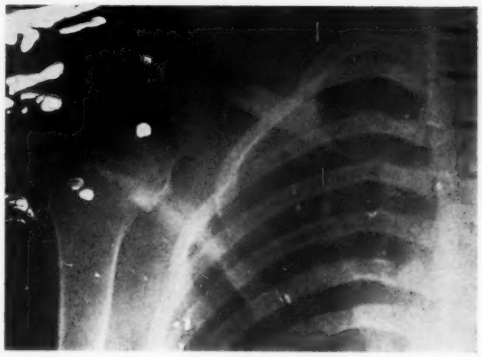

Fig. 1. Roentgenogram made two days after appearance of clinical symptoms, showing absence of the major part of the right scapula.

J. B., a 16-year-old boy, son of a farmer, was admitted to the Surgical Service of the State Hospital at Pelhřimov, on July 25, 1955. The initial complaint was pain in the right shoulder and inability to move the right arm, which developed suddenly while the patient was working in the field. The personal [illegible] contained no points of a pertinent nature. There had been no previous injury. X-ray examination [illegible] days after admission (Fig. 1), showed absence of a major portion of the right scapula. The remnants were the axillary margin of the [illegible], a part of the coracoid process, and a few other small isolated areas. The border of the remaining portion of the scapula was poorly defined and osteoporotic changes were present in the residual bone tissue. The right clavicle was affected in a similar manner. The outer third of this bone had almost entirely disappeared. Roentgenographic examination of the remainder of the skeleton was negative. Laboratory tests showed normal values with the exception of alkaline phosphatase, which was [illegible] 12.5 mg. per cent.

The patient presented features highly [illegible] malignant disease, a biopsy was taken [illegible] part of the right scapula. Histo- [illegible] this specimen resembled an ordinary heman- [illegible] showing proliferation of capillaries [illegible] red blood cells. Some of the capillaries were dilated and reached cavernous proportions (Fig. [illegible]). The pathological diagnosis made on this section was hemangioma without signs of malignancy.

[1] From the Department of Pathology, State Hospital Jihlava, Department of Surgery, State Hospital Pelhřimov and the Department of Roentgenology, State Hospital Jihlava, Czechoslovakia. Accepted for publication in December 1957.

This case will also be reported in Acta Chir. Orthop. et Traum. Bohemoslov.

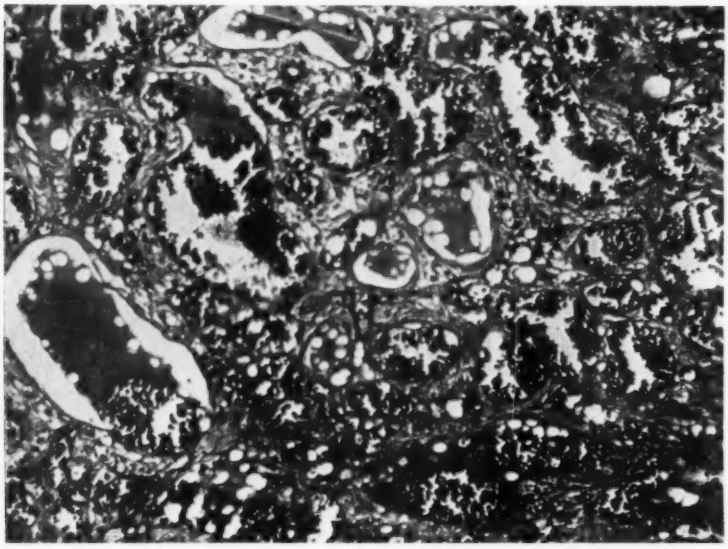

Fig. 2. Photomicrograph of biopsy specimen from residual portion of the right scapula. Note cavernous dilated capillaries of hemangioma containing red blood cells. ×90.

In seeming contradiction of this histologic diagnosis, the clinical course of the disease was that of a fairly rapidly progressing tumor. Three months after the appearance of the first clinical symptoms, x-ray examination showed total absorption of the right scapula, pathological fracture of the right clavicle, and osteoporotic changes in what remained of it. Incipient osteolysis was visible in the head of the right humerus.

Angiography was then performed in an effort to confirm the diagnosis of an angiomatous tumor. Joduron, 40 c.c. of a 70 per cent solution, was injected

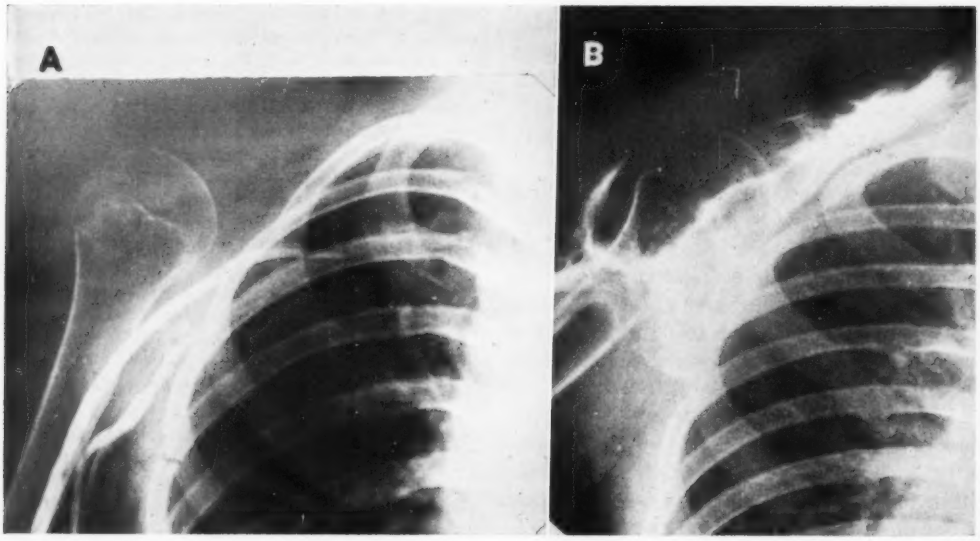

Fig. 3. A. Angiogram following venous injection of Joduron in right cubital vein. The contrast fluid fills the brachial and basilic veins but is blocked off from the axillary vein.
B. Angiogram following injection of Joduron into vessels of the hemangioma in the right scapular area. Note the formation of a homogeneous shadow, which resembles the configuration of the right scapula.

into the right cubital vein and roentgenograms were made at one-second intervals. These films showed a filling of the brachial and basilic veins, but a sharp failure of the axillary vein to receive the radiopaque material (Fig. 3, A). This procedure apparently offered indirect evidence of the presence of an angiomatous tumor in this general region, but without any definite connection with the various channels that had been injected. To provide more direct evidence, the vessels of the tumor itself were injected

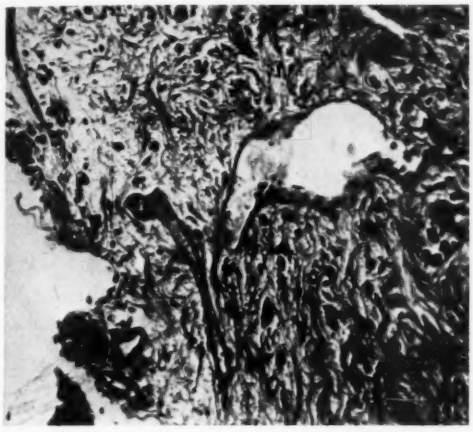

Fig. 4. Photomicrograph of biopsy material taken from the cutaneous sclerosing hemangioma which appeared in the region of the right scapula.

with 20 c.c. of a 70 per cent solution of Joduron. This material was introduced under fluoroscopic control into the area formerly occupied by the right scapula. Roentgenograms made at intervals of one second revealed an angiomatous system in the distal part of this region which had the outline and general appearance of the right scapula (Fig. 3, B).

During the following four weeks a deformity appeared in the right scapular region, resembling that of a dislocation. In the lateral part of the right interscapular area a large cutaneous hemangioma appeared. Histologic sections showed many anastomosing capillaries in meshes of fibrous tissue. Only a small number of these vessels contained red blood cells. The fibrous tissue showed signs of a sclerosing process (Fig. 4). This cutaneous sclerosing type of hemangioma is thought to be due to the extension of the tumorous growth into the soft tissues of the scapular region.

X-ray examination twelve months after the appearance of the first symptoms showed a total absence of the right scapula and clavicle and early osteolytic changes in the right humerus (Fig. 5). All other parts of the skeleton were normal radiologically. During the period of hospitalization deep roentgen therapy was employed without any signs of benefit.

Fig. 5. Roentgenogram made twelve months after the onset of symptoms, showing total absence of the right scapula and right clavicle, with osteolytic changes in the proximal part of the right humerus.

Five weeks later, more advanced osteolytic changes were demonstrated by x-ray in the head of the humerus. The body of the fourth cervical vertebra was now involved, with dislocation of its residual fragment in the dorsal direction. In spite of these findings, the patient felt subjectively well, neurologic examination was entirely negative, and the results of laboratory tests performed were within normal limits. Some time later he was admitted to the Second Clinic for Orthopedic Surgery at Prague. A short period of observation under the Director, Prof. Hněvkovský, disclosed that the disease process was still actively progressive.

On Sept. 18, 1956, the patient was again admitted to the Surgical Division of the State Hospital at Pelhřimov, where he died on Sept. 22, fourteen months after the onset of the first symptoms.

Postmortem Examination

An autopsy was performed forty hours after death. The right scapular region and the proximal part of the right upper extremity were found to be edematous. Both lungs were collapsed. The bodies of the third and fourth cervical vertebrae in their right medial portions were replaced by a soft grayish-red tissue having the appearance of a mass of convoluted blood vessels. This lesion had denuded the spinal cord and produced a free communication between the two pleural cavities; 5,500 c.c. of bloody fluid were present in the common pleural cavity. Bronchopneumonia with some small abscesses was found in the right lung. The bone tissue of the right scapula and the right clavicle was replaced by the same soft grayish-red tissue described above (Fig. 6). The head of the right humerus had undergone similar transformation, and a fracture was to be seen in the region of the anatomical neck. The lower portion of the humerus had the gross aspect of worm-eaten wood. The histologic appearance of the tissue removed postmortem from the former site of the right clavicle is shown in Figure 7.

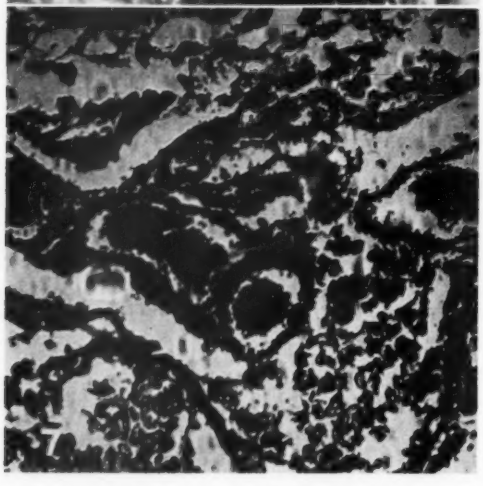

Fig. 6. Autopsy: Gross appearance of soft grayish-red tissue resembling blood vessels which has replaced the bone tissue of the right scapula.

Fig. 7. Photomicrograph of tissue removed post-mortem from former site of right scapula. Typical histologic appearance of a capillary hemangioma.

The photomicrographs indicated the presence of a typical capillary hemangioma. Microscopically the distal part of the humerus was identical with the first biopsy specimen of the scapula.

The cause of death was the total collapse of both lungs produced by massive hemorrhagic exudate associated with bronchopneumonia.

DISCUSSION

The case reported above may be briefly summarized as follows: In a boy aged sixteen years, with no preceding history of trauma, massive osteolysis occurred, leading to death in fourteen months. The right scapula, the right clavicle, the head of the right humerus, and parts of the bodies of two cervical vertebrae completely disappeared during this period. Histologic examination of tissue removed at biopsy showed a cavernous hemangioma with no signs of malignancy. The presence of an angiomatous tumor was established during life by angiography. The post-mortem examination confirmed the diagnosis of massive osteolysis associated with hemangiomatosis.

This case closely resembles Case I of Gorham and Stout (2) and appears to confirm their conclusions that hemangiomatosis is regularly associated with massive absorption of bone, and may well be the cause of it.

It should be mentioned at this point, however, that small hemangiomas of bone are occasionally observed in older people, involving particularly the vertebral bodies or the ribs. These lesions present features that are well known to radiologists and to pathologists. They show sharply defined borders and reveal no tendency to progress toward massive bone absorption.

The actual mechanism involved in massive absorption of bone is still unknown. Laboratory tests in our case and in the series of cases collected by Gorham and Stout shed no light upon this problem. The theory advanced by Leriche that osteolysis may arise due to active hyperemia following trauma has not been generally accepted. There was no history of injury in our patient, though minor trauma cannot be definitely excluded. Because this rare disease occurs for the most part in children and young adults,

one might well consider the possibility of a congenital vascular malformation as an etiologic factor. In this connection it is interesting to note that Ritchie and Zeier (5) have recently described osteolysis of bones associated with angiomatosis of the spleen.

SUMMARY

Another case of massive osteolysis associated with hemangiomatosis is reported. The diagnosis was established by biopsy, angiography, and postmortem examination. The case is in close accord with the observations published by Gorham, Wright, Shultz and Maxon (1) and confirms the conclusion of Gorham and Stout (2) that massive osteolysis may be caused by hemangiomatosis of bone.

ACKNOWLEDGMENTS: The authors are much indebted to Assistant Professor Bednář of Prague for his study of the histological sections, to Dr. Gorham and to Dr. Stout for reviewing this paper and the sections, and to Professor Hněvkovský of Prague for clinical data supplied following the study of the patient on his service.

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SUMMARIO IN INTERLINGUA

Osteolyse Massive Causate Per Hemangiomatosis. Reporto De Un Caso de Morbo de Gorham Con Necropsia

In un adolescente de dece-sex annos de etate, sin historia de trauma, osteolyse massive occurreva con exito mortal post decequatro menses. Durante iste periodo, le scapula dextere, le claviculo dextere, le capite del humero dextere, e partes del corpores de duo vertebras cervical dispareva completemente. Le examine histologic del histos excidite pro objectivos bioptic revelava un hemangioma cavernose sin ulle signo de malignitate. Le presentia de un tumor angiomatose esseva establite angiographicamente durante le vita del patiente.

Le morte esseva causate directemente per le collapso total de ambe pulmones in consequentia de un massive exsudation hemorrhagic que esseva associate con bronchopneumonia. Le examine post morte confirmava le diagnose de osteolyse massive associate con hemangiomatosis.

Iste caso resimila intimemente le caso reportate per Gorham e Stout e pare confirmar le conclusion de ille autores que hemangiomatosis es regularmente associate con un absorption massive de osso e pote ben esser le causa de illo.

Neurofibromatosis: Clinical and Roentgen Manifestations[1]

BERTRAM LEVIN, M.D.[2]

VON RECKLINGHAUSEN'S neurofibromatosis is generally thought of in terms of its skin manifestation. Indeed, it is defined as "a condition . . . marked superficially by the formation of multiple pedunculated soft tumors (neurofibromas) distributed over the entire body and associated with areas of pigmentation" (1). Were these the sole manifestations, the diagnostic roentgenologist need not be concerned with this disease, which is certainly not a rare one. The skin changes, however, are only the most common sign; there are numerous other clinical manifestations. Similarly, there are many and varied roentgenologic findings involving many of the organ systems. Awareness of the roentgenologic appearances would permit easy recognition of many forms which neurofibromatosis may take.

From experience encountered in a general hospital, a number of cases are being reported to show the variety of roentgenologic findings and clinical manifestations associated with neurofibromatosis. These cases are chosen because the roentgenograms lend themselves to satisfactory reproduction or because they are of unusual clinical interest. No attempt has been made to present a complete review of multiple neurofibromatosis as seen in this hospital. It is hoped that the material

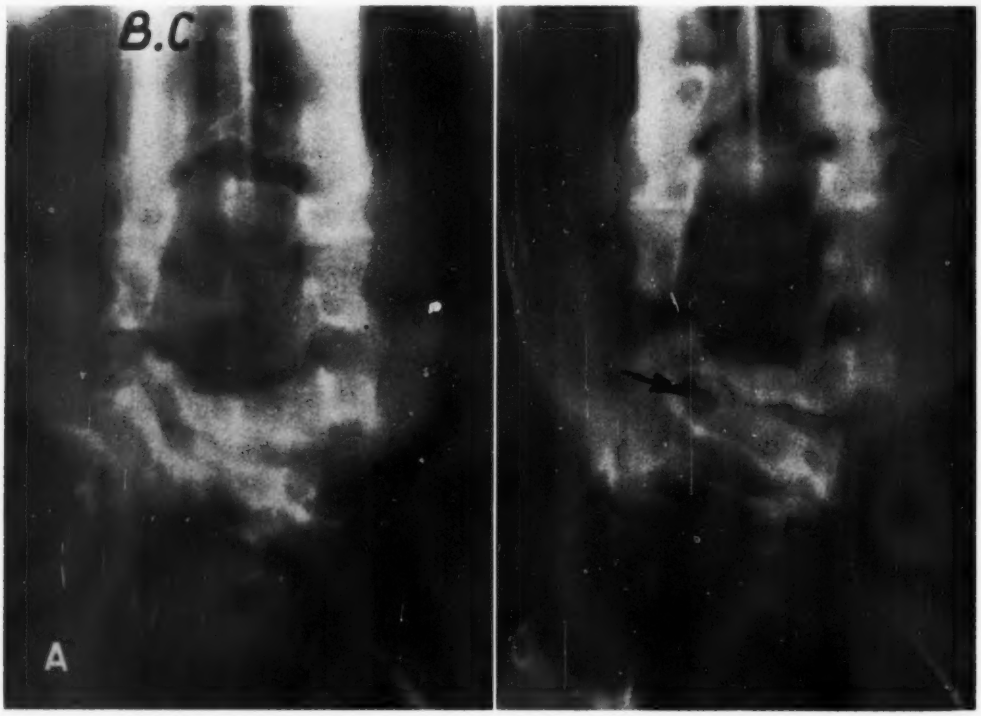

Fig. 1A. Case I. Cervical scoliosis. Frontal tomograms reveal bilateral pedicle destruction and vertebral body "wedging." See also Fig. 1B, on opposite page.

[1] Accepted for publication in December 1957.
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will be of sufficient interest to alert the reader to the possibility of encountering similar examples.

CASE REPORTS

CASE I: B. C., a 38-year-old Negro female, obviously a mental defective, was admitted to the hospital because of a painful swelling over the left forearm. Multiple soft subcutaneous nodules of varying size, up to 4 cm. in diameter, were said to have been present since birth. There was moderate

Fig. 1B. Case I. Cervical scoliosis. The vertebral collapse and severe kyphosis are more evident in the lateral view.

scoliosis of the upper dorsal spine. *Café au lait* spots were scattered over the trunk and extremities. No abnormal neurologic sign or symptom was present. An older sister had had similar tumors removed some years earlier at another hospital.

One of the nodules was removed from the left forearm and proved to be a typical neurofibroma.

Roentgenograms revealed destruction of the pedicles of C-5, 6, and 7 and of the vertebral articulating portion of the left first rib (Fig. 1). There was marked kyphoscoliosis secondary to the destructive process. In the medial portion of the left ilium there was extensive bone erosion (Fig. 2). It is of interest that the largest subcutaneous nodules overlay this area. These destructive changes were undoubtedly due to neurofibromatosis. Scoliosis of the dorsal spine was readily apparent, but no bone defect was evident to account for this. A complete skeletal survey revealed no other abnormality.

Fig. 2. Case I. Large excavation in the cephalomedial aspect of the left ilium and adjacent sacrum. The largest subcutaneous nodules overlay this area.

CASE II[3]: R. G., a 5-year-old white girl, was seen because of obvious disparity in length of the lower extremities. The left leg was 1 5/8 inches longer than the right and was 2 inches greater in circumference at the calf. The patient had multiple subcutaneous nodules over the trunk and extremities, some as large as a hazelnut. There were numerous *café au lait* spots over the entire body, most pronounced over the left leg.

The overgrowth of the leg had first been noticed at five months. There was no pain over bone or in the subcutaneous nodules. The mother also had *café au lait* spotting and multiple skin nodules, one of which had been removed and diagnosed as a neurofibroma. The maternal grandmother was similarly affected.

A film of the lower extremities showed increased length of the tibia and fibula and increased width of the left leg (Fig. 3). Though no biopsy was obtained, the physical findings and the history presented incontrovertible evidence of neurofibromatosis.

CASE III: R. M., an 8-year-old Negro boy, gave a history of scoliosis since birth, becoming appreciably more severe in the past six months. *Café au lait*

[3] This case has previously been reported in greater detail (11).

Fig. 3. Case II. Marked linear overgrowth of the left tibia and fibula. Multiple subcutaneous nodules and abnormally thick soft tissue are present on the left.

pigmentation was present over the trunk and extremities and there were multiple subcutaneous nodules along the course of the intercostal nerve and on the extremities. Physical examination revealed a severe dorsolumbar scoliosis. There was no neurologic deficit. There was no history of neurofibromatosis in the family.

Roentgen examination revealed moderate scoliosis, with the maximal curvature at the level of the ninth thoracic vertebra (Fig. 4). There was extensive erosion of the fifth through the eighth thoracic vertebral bodies. Some of the adjacent ribs were so severely eroded that portions of them appeared pencil-line thin. The posterior margins of the mid-dorsal vertebrae were deeply eroded and presented a scalloped appearance.

The *café au lait* spots, the subcutaneous nodules, and the roentgenographic findings permitted the unequivocal diagnosis of von Recklinghausen's neurofibromatosis.

CASE IV: L. G., a 5-year-old Negro boy, had been well until one year of age, at which time a mass appeared on the right side of the upper back. This continued to grow until the child was brought to the hospital. He had never suffered any pain or disability. His mother, maternal grandmother, and a maternal uncle had previously been found to have neurofibromatosis. A progressing type of scoliosis was first evident at about one year and there appeared to be delay in growth and development. Marked upper dorsal kyphoscoliosis was apparent, as were numerous *café au lait* spots over the trunk and extremities. A firm, nontender mass, about 10 cm. in diameter, was present over the right scapula. The skin over this mass was heavily pigmented and hairy and there was ulceration over the lower pole. The tumor was removed and proved to be a solid

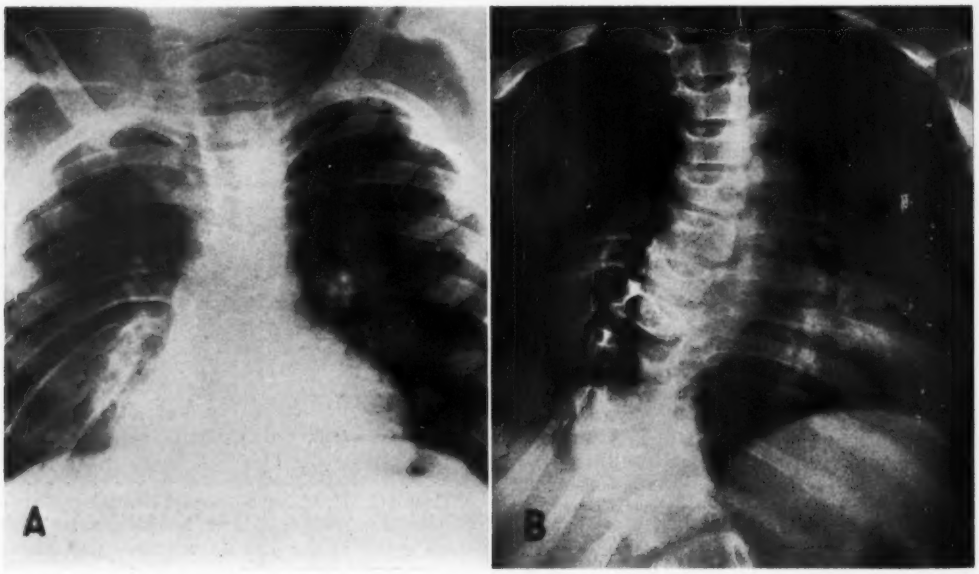

Fig. 4A and B. Case III. A. Pressure erosion of right ribs, one narrowed to pencil-line thinness. B. Dorsal scoliosis of moderate degree. See also Fig. 4C, on opposite page.

structure, histologically a typical neurofibroma.

Roentgen survey of the skeleton showed a severe, sharply angulated kyphoscoliosis at the midthoracic level. The overlap of bony structures in the spine made it impossible to visualize the anatomic detail completely. There was marked erosion of a number of mid-dorsal vertebral bodies as well as of the adjacent ribs (Fig. 5). The large subscapular soft-tissue mass was readily discernible on the roentgenograms.

CASE V: K. J., a 16-month-old white boy, had presented a feeding problem since the age of nine months. He had occasional episodes of vomiting and had suffered moderate weight loss. On physical examination the child appeared underdeveloped and undernourished. There were several small, firm nodules palpable in the abdominal wall and numerous *café au lait* spots were scattered over the abdomen and back. The optic disks were white, indicating optic atrophy. In view of the relatively frequent association of optic nerve tumor and neurofibromatosis, a diagnosis of glioma of the optic chiasm was made.

Films of the orbits (Fig. 6) revealed enlargement of both optic foramina, further confirmation of an optic tract tumor. Pneumoencephalographic study revealed no additional abnormality.

CASE VI: R. S., a 4-year-old Negro boy, was well until the age of about three and a half years, when

Fig. 4C. Case III. Scalloping of dorsal vertebral bodies due to pressure erosion.

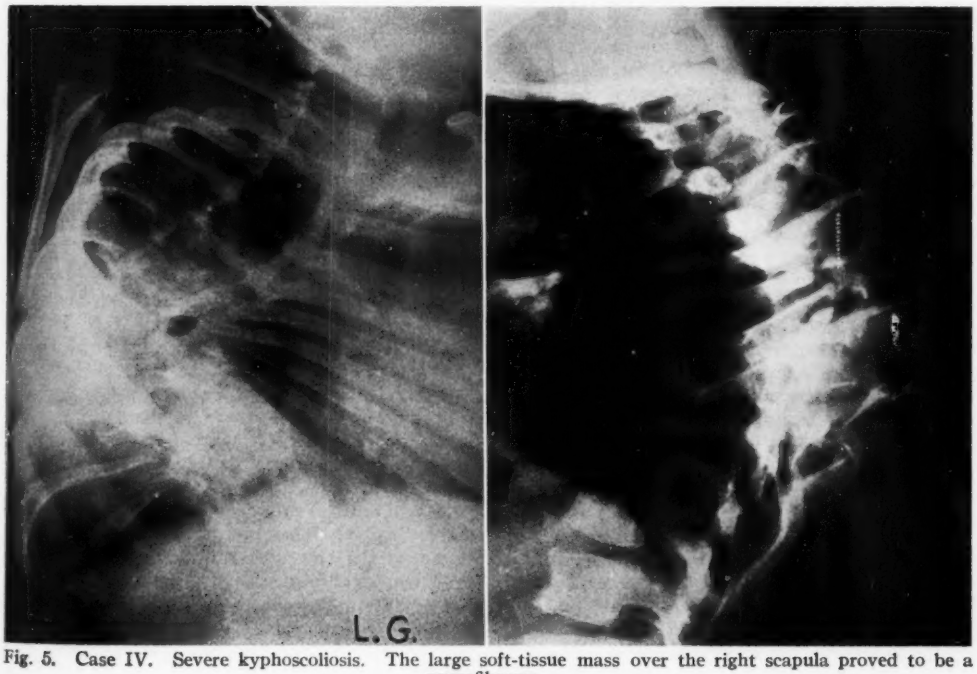

Fig. 5. Case IV. Severe kyphoscoliosis. The large soft-tissue mass over the right scapula proved to be a neurofibroma.

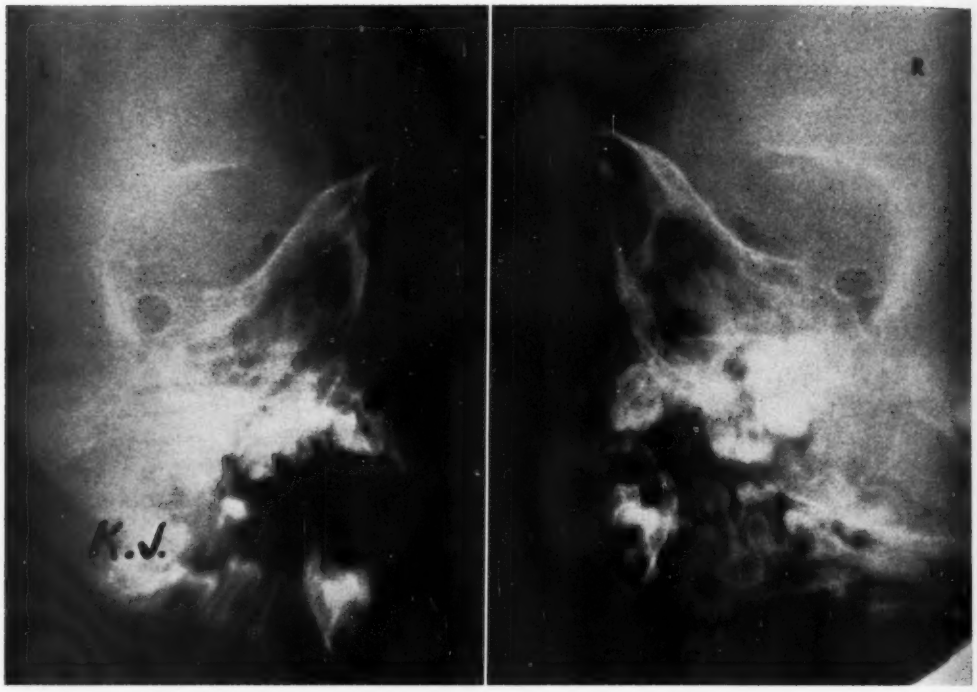

Fig. 6. Case V. The optic foramina enlarged to approximately 6 × 8 mm. bilaterally.

severe anorexia and pallor developed. Birth and development had been normal. On admission to the hospital there was moderate hepatomegaly. Small *café au lait* spots were scattered over the trunk. There were no palpable skin nodules. No family history of neurofibromatosis was obtained. There was a severe pancytopenia: hemoglobin 4.8 gm., 1,400,000 red blood cells per c.mm., 4,800 white blood cells, 5.2 per cent reticulocytes, 22,000 platelets per c.mm., macrocytosis, microcytosis, polychromatophilia, anisocytosis, and poikilocytosis. The test for red corpuscle sickling was negative. The bleeding time was eight minutes. Repeated bone marrow aspirations revealed marked marrow hypoplasia. The diagnosis was hypoplastic marrow syndrome associated with a mild hemolytic process and a thrombocytopenic purpura.

Roentgen examination revealed varying degrees of erosion of the pedicles of the fifth to tenth dorsal vertebrae bilaterally, more marked on the left (Fig. 7). It was believed that these changes were due to multiple dorsal root tumors with extension along the intercostal nerves, and a diagnosis of von Recklinghausen's neurofibromatosis was made. A complete skeletal survey failed to disclose any other bone defect. There was no scoliosis.

The child suffered nasal hemorrhages and hematemesis which required repeated blood transfusions. Massive bilateral subdural hematomas then developed; surgical treatment was unsuccessful, and death ensued at the age of fifty-nine months. A limited postmortem examination disclosed no evidence of neurofibromatosis. However, the areas which were seen to be involved on the roentgenograms could not be studied at autopsy. In view of the marked and characteristic bone changes associated with the *café au lait* pigmentation, it is felt that this case could properly be classified as one of von Recklinghausen's neurofibromatosis.

CASE VII: R. F., an 8-year-old white boy, was admitted to the hospital because of sudden enlargement of the genitalia, beginning three months earlier. The child was in generally good health except for frequent headaches. He had numerous *café au lait* spots over the trunk as well as a single subcutaneous nodule in the lumbar region. His mother and maternal grandmother were known to have neurofibromatosis and his younger brother exhibited multiple *café au lait* spots. The child's penis and testicles were found to be larger than normal for his age. There was no pubic or axillary hair (some months later pubic hair did appear). Studies to evaluate adrenal activity showed no definite abnormality. There was no gross neurologic abnormality. Testicular biopsy revealed a well-developed testis with mature spermatogonia and spermatocytes. A destructive tumor in the floor

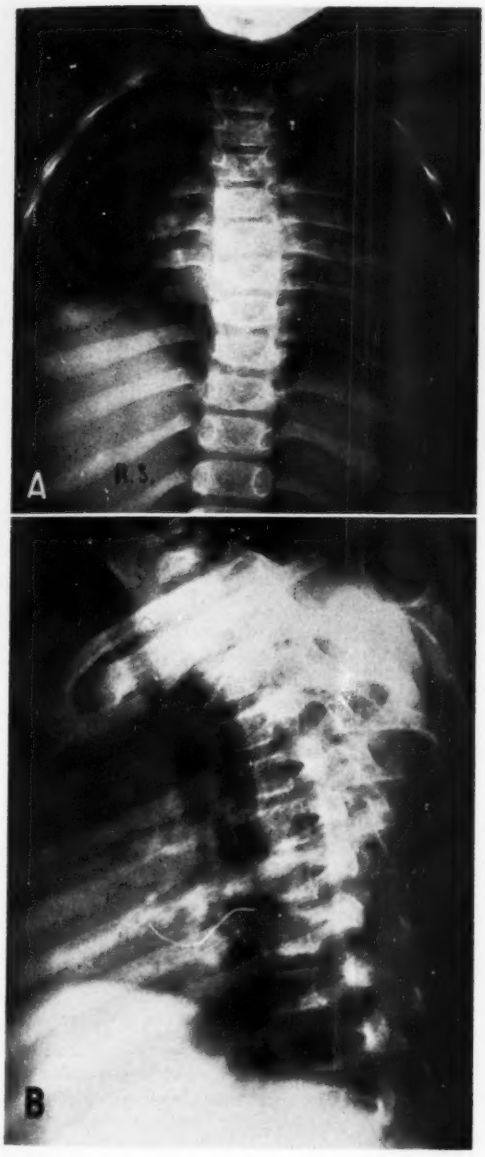

Fig. 7. Case VI. A. Marked bilateral pedicle narrowing and left rib erosion. B. The lower dorsal vertebral bodies are eroded posteriorly.

of the third ventricle was suspected. Pneumoencephalography was performed but showed no abnormality.

Complete roentgen studies were done, but the only positive finding was narrowing of the right pedicle of the first lumbar vertebra (Fig. 8). This was interpreted as being secondary to an intraspinal tumor, although the interpedicular space at this level was within the limits determined by Simril and Thurston (10).

Fig. 8. Case VII. Narrowing of the right pedicle of T-1 was the only roentgenologic abnormality noted. The only subcutaneous nodule this patient had was over this area.

This case is presented not because of an unusual roentgen manifestation but to illustrate further the variety of clinical forms that neurofibromatosis may take. Though there is no proof, it is reasonable to suspect that the macrogenitosomia is secondary to an intracranial tumor. Also the case illustrates minimal roentgen findings, in contrast to the advanced vertebral changes reported in Cases I, III, and IV.

CASE VIII: B. I., a 39-year-old white male, first had a chest roentgenogram because of suspected pneumonia. A large, right, posterior mediastinal mass was discovered (Fig. 9). In the left lung apex nodular fibrocalcific disease was found; there was no history of tuberculosis. At about the same time small, firm, nontender soft tissue masses were discovered over the inner aspect of the right thigh. The mediastinal mass and one from the thigh were removed and proved to be neurofibromas.

CASE IX: Following an automobile accident, A. S., a 17-year-old white male, had a chest film made which disclosed a mass in the right upper lung field posteriorly (Fig. 10). The patient had multiple subcutaneous nodules over both arms and *café au lait* spots over the extremities and trunk. Similar nodules were present on the arms of his father, paternal uncle, and paternal grandmother.

At surgery an extrapleural tumor mass, approxi-

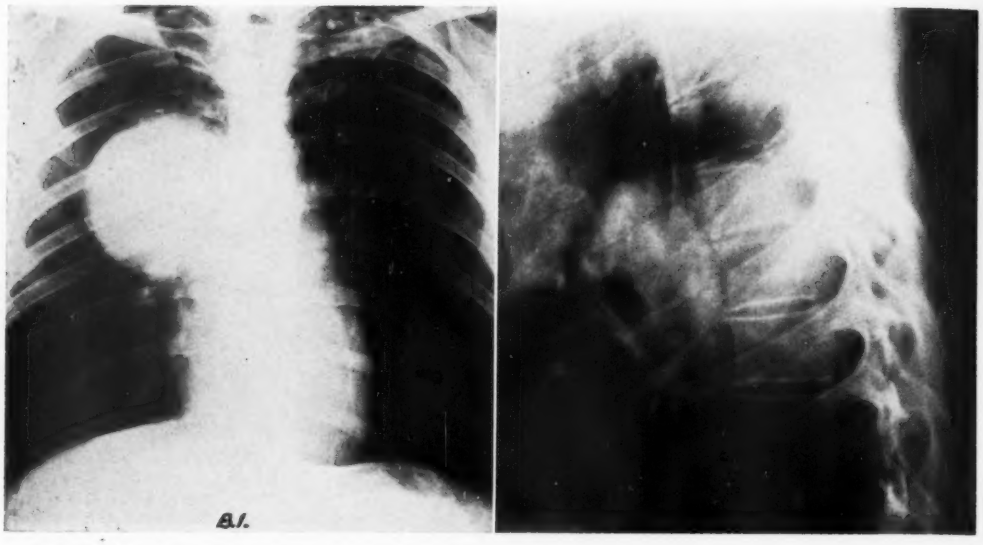

Fig. 9. Case VIII. A large posterior mediastinal mass, which was proved to be a neurofibroma.

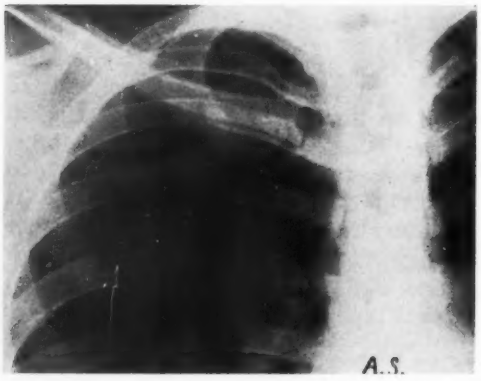

Fig. 10. Case IX. A right upper lung field mass which lay far posteriorly. This was a neurofibroma, adherent to the underside of the fourth rib.

mately 3.5 cm. in diameter, was found adherent to the under-surface of the fourth rib and its musculature. This proved to be a neurofibroma.

CASE X: R. W., a 44-year-old white female, was admitted to the hospital for mastectomy because of a mass in the right breast. She had multiple subcutaneous nodules over the left pectoral area and left arm. There were a number of *café au lait* spots in the left infraclavicular area.

Preoperative chest roentgenograms revealed two nodular shadows in the left infraclavicular area, lying far anteriorly, intimately related to the pleura (Fig. 11). No previous chest films were available. The problem was one of metastases *versus* neurofibromas. Because of the roentgen appearance of the masses, their location, the grouping of the intrathoracic nodules relative to the subcutaneous nodules, and the *café au lait* spots, it was felt that the intrathoracic nodules were extrapleural neurofibromas.

A right radical mastectomy was performed, and two subcutaneous tumors were excised from the left pectoral area. The breast tumor proved to be a primary papillary intracystic adenocarcinoma. The skin nodules were "dermal neurofibromas of the von Recklinghausen's variety."

The left intrathoracic masses have not changed in appearance in over a year. For this reason, it is felt that they can rightfully be considered to be neurofibromas.

CASE XI: T. B., a 49-year-old Negro male, was admitted to the hospital because of gastrointestinal complaints. He had had grand mal seizures since childhood. There were multiple firm subcutaneous nodules over the chest and abdomen as well as *café au lait* spotting in the interscapular area. The patient was severely hypertensive.

Routine frontal views of the chest revealed multiple, round, nodular shadows in both lung fields, not unlike those cast by pulmonary metastases (Fig. 12). The skin nodules over the chest were then painted with barium paste and a repeat film showed that the nodular shadows were all due to the neurofibromata. A film of the abdomen revealed similar shadows cast by the abdominal or subcutaneous nodules.

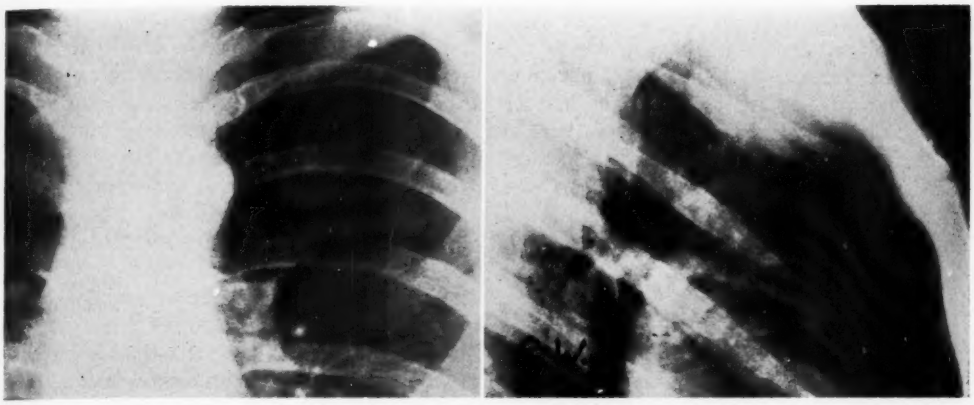

Fig. 11. Case X. Frontal and lateral views of left upper lung field masses which lay far anteriorly. They have undergone no change in over one year. The only subcutaneous nodules this patient had overlay this area.

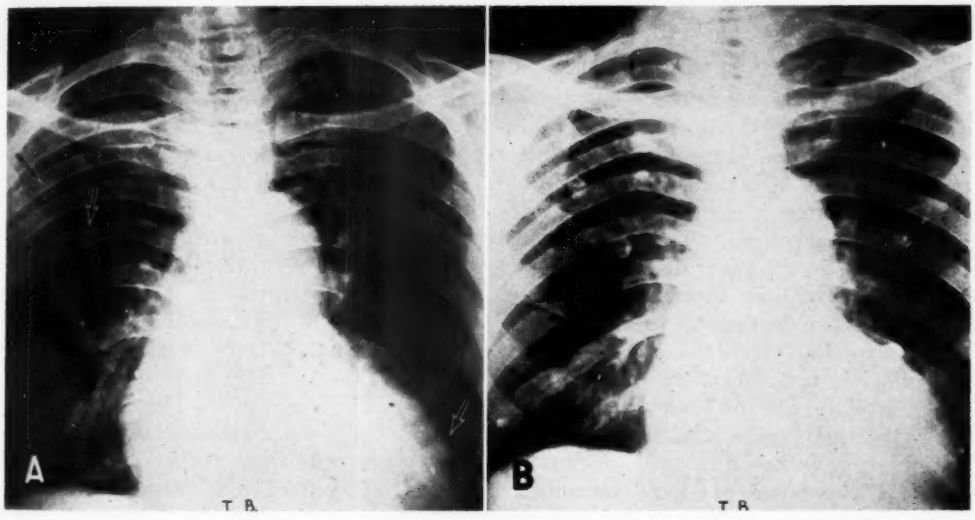

Fig. 12. Case XI. A. There are multiple round nodular shadows in both lung fields. Most do not show satisfactorily in the roentgenogram. B. Repeat film made after painting the skin nodules with barium paste. Similar nodules were noted in abdominal films but would not show on roentgenograms.

In the author's experience one of the more common roentgenologic findings in neurofibromatosis has been superimposition of subcutaneous nodules on the chest or abdominal fields. Without benefit of clinical information, this might easily lead to erroneous interpretation.

DISCUSSION

Fairbank (2) notes that males are more commonly affected with neurofibromatosis than are females; 8 of the 11 cases herein presented were in males. A familial incidence has often been noted and appears to be well established; 5 of our 11 patients gave a definite family history of the disease. Garland (3) described four brothers showing various manifestations of neurofibromatosis. Mental deficiency is a common concomitant; one of the patients in the present series was an obvious mental defective. No significant racial preponderance has been noted.

The most comprehensive report on the

skeletal changes in neurofibromatosis is that of Holt and Wright (4), which appeared in RADIOLOGY in 1948. The reader is referred to this fine treatise for an historical bibliography on the subject as well as for excellent case material and a thorough discussion. In the past decade, no new roentgenologic findings have been reported. Holt and Wright classified the types of skeletal abnormality as follows:

1. Erosive defect due to the presence of neurofibromas contiguous to bone.
2. Scoliosis.
3. Disorders of growth, including both overgrowth and underdevelopment.
4. Bowing and pseudarthrosis of the lower leg.
5. Intraosseous cystic lesions.
6. Congenital anomalies.

Scoliosis is the most common skeletal alteration associated with neurofibromatosis and, as can be judged from the cases presented, may be severe. Miller (7) and Kerr (5) reported examples of such severity as to cause paraplegia. The scoliosis most often occurs in the lower dorsal region and is associated with an appreciable kyphosis. The curvature is due to the destructive changes in the vertebral bodies caused by the multiple neurofibromata of the dorsal roots eroding the adjacent bone. It is likely that some cases considered to be idiopathic scoliosis are due to neurofibromatosis. If this possibility were remembered and a search made for other manifestations of the disease, neurofibromatosis would probably be implicated in more cases of scoliosis than at present.

Rib erosion secondary to neurofibromas of the intercostal nerve presents a pathognomonic picture when the "twisted-ribbon" appearance (a term aptly coined by Holt and Wright) is seen and a suggestive picture in its less severe form. Rib narrowing of any degree in conjunction with scoliosis is good presumptive evidence of neurofibromatosis. The erosive changes in the long and flat bones may be severe. The defect caused by erosion by the adjacent nerve tumors has been called a "pit or cave" defect, and in long bones is characteristically long relative to its depth.

The cause of bone overgrowth in neurofibromatosis has not been well established but it is attributed to increased blood supply to the area of the soft-tissue tumors, with resultant periosteal hyperemia.

None of the present cases showed orbital defects. Such defects occur and are usually in the superior portion of the orbit and are associated with pulsating exophthalmos (9). In the series of Holt and Wright, one such patient had nearly complete absence of the sphenoid bone. Nor did any of our cases demonstrate pseudarthrosis of the leg or over-constriction of long bones, which have been described in other reports (4, 8).

The frequent association of optic gliomas and von Recklinghausen's disease is well known. Marshall (6) emphasized this relationship in a comprehensive report on glioma of the optic nerve appearing as a manifestation of von Recklinghausen's disease. The association is so common that, in any person with peripheral manifestations of neurofibromatosis who has some visual disturbance, a glioma of the optic chiasm or nerve should be suspected.

Mediastinal neurofibromas most commonly present as discrete posterior mediastinal masses, usually in the upper dorsal region. They more commonly exist as isolated neurofibromas rather than as one lesion of generalized neurofibromatosis. The tumor originates in the spinal canal and extends through the neural foramen into the adjacent extrapleural space. Proper oblique films of the spine may disclose enlargement of the neural foramen; frequently this cannot be demonstrated. If this erosion is seen, it permits a positive diagnosis of neurogenic tumor. If not, one may well be dealing with some other tumor. Figure 13 shows a tumor situated medially and posteriorly in the chest, round and discrete in outline. This was thought to be a mediastinal neurofibroma. Surgery proved it to be a highly anaplastic bronchogenic carcinoma. Case IX represents an intrathoracic extrapleural neuro-

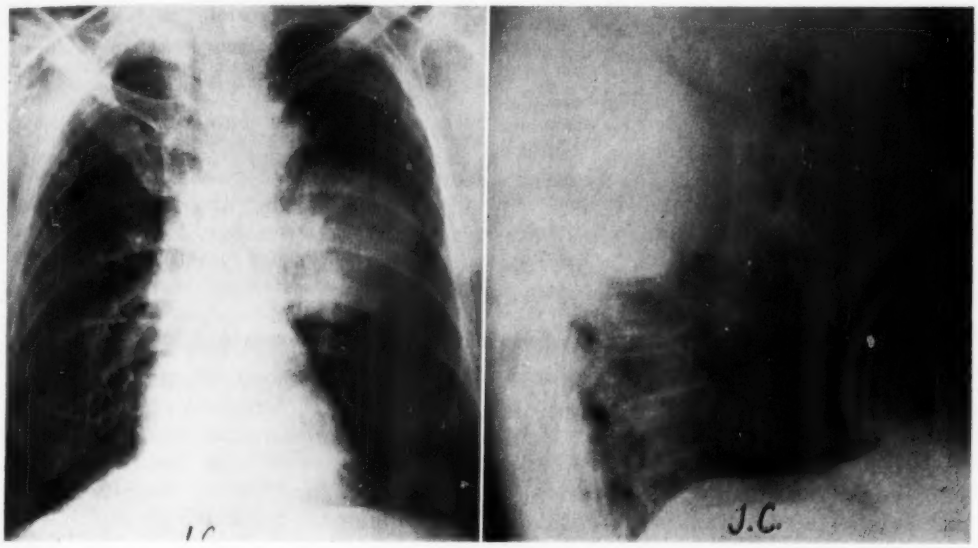

Fig. 13. Frontal and lateral views of the chest demonstrating a round posterior lung field mass. This proved to be a highly anaplastic bronchogenic carcinoma.

fibroma arising from a less common site, an intercostal nerve, and appearing as a solid mass on the chest roentgenogram. Case X is undoubtedly the same.

It is doubtful whether the association of neurofibromatosis and aplastic anemia in Case VI was more than coincidental. Cases of neurofibromatosis with hemolytic anemia have been reported, but the English literature contains no previously reported instance of neurofibromatosis with aplastic anemia. Certainly it seems better at this time to consider our case as representing two co-existent diseases rather than to attribute the aplastic anemia to the neurofibromatosis.

Nor is there definite proof that in Case VII the precocious sexual maturation was related to the generalized neurofibromatosis. This is an interesting conjecture and there is a good possibility that it is true. Wilkins (12) has proved that sexual precocity may be secondary to intracranial tumors arising in the anterior or posterior region of the hypothalamus. If these tumors are slow growing, they may present no other sign of their presence. It is well known that there is an unduly high incidence of intracranial tumors associated with neurofibromatosis. These may be meningiomas, gliomas, or other histologic types. Though pneumoencephalographic study was negative in this case, one can certainly not exclude an infiltrating tumor.

SUMMARY

A series of cases of neurofibromatosis is presented, with different roentgenologic findings or presenting unusual clinical manifestations. These include axioskeletal defects, optic foramina expansion, subcutaneous nodules, mediastinal and intercostal masses, and bony overgrowth. Of special interest is a case of a child with precocious sexual maturation and another of a child with an unexplained aplastic anemia.

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Note: The reader is referred to the papers of Holt and Wright and of Marshall for excellent bibliographies.

SUMMARIO IN INTERLINGUA

Neurofibromatosis: Manifestationes Clinic E Roentgenographic

Es presentate un serie de casos de neurofibromatosis characterisate per varie aspectos roentgenologic o inusual manifestationes clinic. Istos include defectos axioskeletic, expansion de foramine optic, nodulos subcutanee, massas mediastinal e intercostal, e excessos de crescentia ossee. De interesse es le caso de un juvene patiente con precoce maturation sexual e illo de un altere con inexplicate anemia aplastic. Omne relation inter iste conditiones e le neurofibromatosis remane sin prova.

The Roentgen Examination of the Lymphatics in Man[1]

DR. R. GERGELY

ROENTGEN EXAMINATION of the lymphatics *in vivo* has a relatively meager history as compared with arteriovenous studies. This may be accounted for by the fundamental differences between the two systems. Monteiro (1) and his collaborators (Rodriguez, Sousa Pereira, and Carvallo) in 1930 performed adenolymphography in animals; Thorotrast injected into the lymph nodes entered the lymphatic trunks, rendering them demonstrable roentgenographically. Menville and Ané (2) in 1932 reported studies in rats and dogs in which they were able to visualize the popliteal, inguinal, axillary, and mesenteric nodes following subcutaneous injections of thorium dioxide into the tails and legs. Zhdanov (3) was one of the first to inject the contrast medium directly into the lymphatics in experimental animals and human cadavers (1932). In the ensuing decade, numerous investigators sought to obtain visualization of the lymph channels by injection of contrast media into the various body cavities and soft tissues—into the peritoneum, pericardium, pleura, and uterus, subdurally and subarachnoidally, into the joints, bronchi, accessory sinuses, muscles, tendons, tongue, tonsils, testis, and epididymis (4, 5, 6).

Pfahler (7) appears to have been the first to demonstrate the lymphatics in man. In the search for a focus of infection in a patient with enlarged lymph nodes, Lipiodol was injected into the maxillary sinus and on films obtained ten weeks later the lymphatic channels were apparent. With the recent introduction of new technics and the more general employment of contrast media, demonstration of the lymphatic system has attracted increasing attention. The procedures are of two types, indirect and direct.

Indirect Lymphangiography: In 1933 Hudack and McMaster (8) showed that solutions injected into the connective tissue appeared within a few minutes in the efferent lymph trunks. It is upon this physiologic phenomenon that indirect lymphangiography is based. Duranteau and his collaborators (9) found a water-soluble medium preferable for this purpose, since oily solutions are more slowly absorbed and are fixed in part by the endothelial lining of the lymph vessels.

In recent years there has been a considerable volume of experimental work on indirect lymphangiography. Servelle (10) demonstrated the lymph nodes and vessels of the neck in dogs following the introduction of a contrast medium under the oral mucosa. Rusznyák (11), who was the first to perform lymphangiography in Hungary, examined the innervation of the lymphatics by this means. Arnulf, Benichoux *et al.* (12) carried out studies on the limbs of dogs, and Collette and Toussaint (13) on the ears of rabbits. Vachtel (14) reported observations on the lymphatic circulation and regeneration of the lymph vessels in experimentally produced chilblains and burns. Filling of the thoracic duct was achieved by Duranteau and his associates (9) after intra-abdominal injection of the medium, and peristaltic activity of this structure was demonstrated by Privesz (15), with the aid of kymography. Proux and Leger (16) visualized the lymph trunks originating from the glenoid cavity. Conti, Mussa, and Fonda (17) examined the lymphatic circulation of the lower extremities following arterial and venous ligation, and Leenhardt and Colin (18) studied the afferent and efferent lymphatics, experimentally.

In 1949 Földi, Rusznyák and Szabó (19) called attention to the effect of hyaluron-

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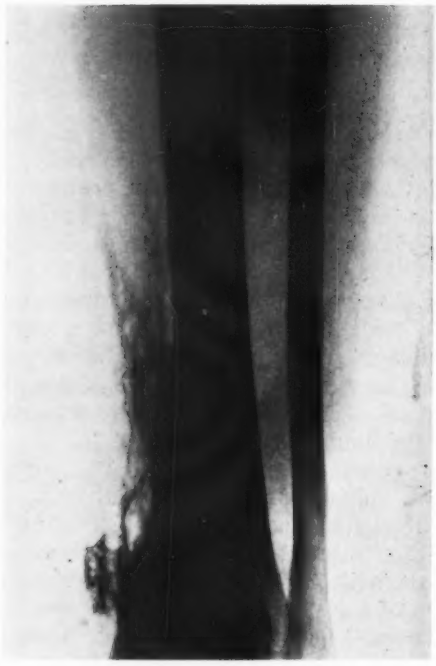


Fig. 1. Roentgenogram obtained twenty minutes after subcutaneous injection of 10 ml. of contrast medium in combination with hyaluronidase. Lymph vessel filling is not demonstrated.

idase in increasing the absorption of substances of high molecular weight by the lymph capillaries. Collette (20) showed that lymphatic visualization was speeded up and extended by the addition of hyaluronidase to the contrast material. The time required for the medium to reach the lymphatics was found by Barbera and Li Castri Patti (21) to be reduced to a third by this means.

A microradiographic technic for lymphangiography was introduced by Collette (22) in 1953 and Bellman and Odén (6) adapted this to their studies of the lymphatic circulation in rabbits.

While indirect lymphangiography has proved to be a good method for studying the lymphatic circulation and related problems in animals, it has not been found to be satisfactory in man, either as reported in the literature or in our own experience. In one case 10 ml. of 70 per cent Joduron (a preparation of Diodrast type) with hyaluronidase was injected subcutaneously in the leg, but no filling of the lymphatics was obtained (Fig. 1).

Direct Lymphangiography: In man lymphangiography can be performed only by the direct injection of the contrast medium into the lymph vessels. Percutaneous injection into dilated lymphatics, vesicles, or cavernous lymph tumors has been found possible (Servelle, 10), but this method can be applied only exceptionally, under pathologic conditions.

The procedure of Kinmonth and Taylor (23), reported in 1954, represents a turning point in the field of lymphangiography. It has been employed by various workers—Kinmonth (24–27); Arnulf (28); Leenhardt (29); Collette (30); Kaindl and collaborators (31); Gergely (32, 33). With this method we have made 60 studies on the lower limbs, some normal and some pathological. The present report is concerned with the normal lymphatics, and the lymphatics in lymphedema and chronic venous insufficiency.

NORMAL LYMPHATICS OF THE LOWER EXTREMITIES

In any operation a great number of lymphatics are cut. Except for the mesenteric vessels, carrying chyle, it is with difficulty that the lymph channels are identified at surgery. Normally they are very fine and are filled with colorless lymph; their walls are thin and transparent and blend imperceptibly with their surroundings. They may, however, be outlined by the injection of a dye—patent blue—which sharply demarcates them from the adjacent tissue. Kinmonth and Taylor made use of this procedure to delineate the vessels prior to injection of the contrast medium. In the dorsum of the foot the lymphatics are 1.0 mm. in diameter and are thus suitable for direct injection.

In the lower limbs a superficial and a deep lymphatic system are distinguished. Clinically the superficial lymphatics pass above the aponeurosis of the limb into

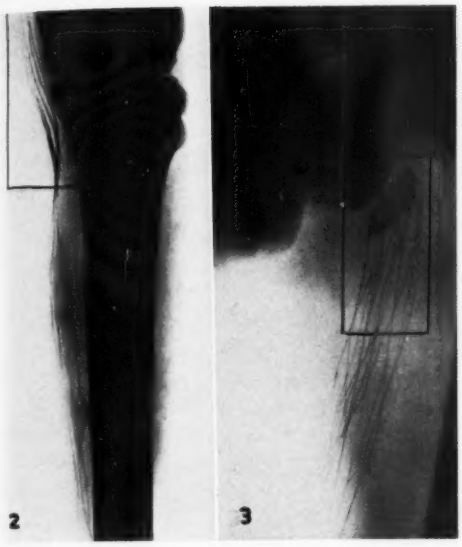


Fig. 2. Medial lymphatics of the leg. Normal.
Fig. 3. Medial lymphatics of the thigh. Normal.

the connective tissue just beneath the skin. It is these vessels that are most frequently involved in lymphedema.

The superficial lymphatics are demonstrable by lymphangiography. They form several groups differing from one another in position and number. Knowledge of these individual groups is essential for evaluation of the lymphangiogram.

The *medial lymphatics* lie on the medial side of the tibia, close together and parallel to one another. They follow in general the course of the great saphenous vein to the superficial subinguinal nodes. Their number varies from one to four (Fig. 2). As the course of these vessels is followed upward from the dorsum of the foot, they are seen to bifurcate at about the height of the knee joint so that their number is proportionately increased. In the thigh they are situated in close proximity to one another on the medial side of the femur (Fig. 3). If contrast material is injected above the ankle into one of the lymph vessels running beside the great saphenous vein, there will usually be filling of one lymphatic trunk in the leg (Fig. 4). In both the lower leg and the

Fig. 4. The medial lymphatics of the lower extremity. Normal.

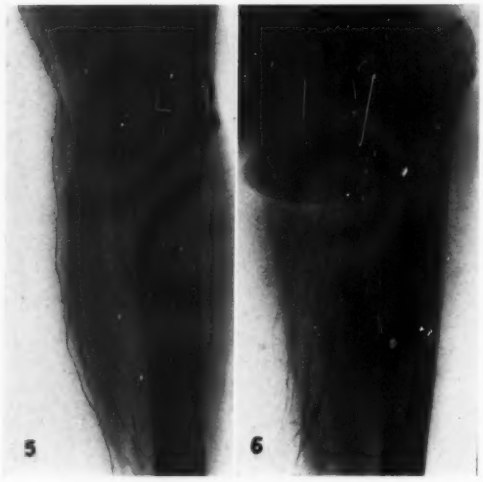


Fig. 5. Lateral lymphatics of the leg. Normal.
Fig. 6. Lateral lymphatics of the thigh. Normal.

thigh the lymphatics are thin, thread-like, slightly wavy in outline, and of uniform diameter.

The *lateral lymphatics* arise from the outer side of the foot, curve around the lower third of the leg and thence pass upward on the medial side. The vessels of this group are more "wavy" than those of the medial group; they are further apart, and in general are more numerous (Fig. 5). At the height of the knee joint they converge into a few branches, the distance between them increases, and they appear as even lines (Fig. 6).

Still a third group—the *posterior*—follow the lesser saphenous vein, but these are few in number and without clinical significance.

All the superficial lymphatics of the lower extremity terminate in the lymph nodes of the superficial inguinal ganglion (Figs. 3 and 4). The number of afferent lymphatics always exceeds that of the efferent (Fig. 7). For the maintenance of normal lymph circulation the lymphatics are supplied with valves situated quite close together. On the roentgenogram these valves are clearly visible, having the form of a spindle.

Even under normal conditions the lymphangiogram may show variations as to the number and location of the lymphatics, but these always exhibit certain characteristics; they are thin, of the same diameter, straight or slightly wavy, and their course is chiefly on the medial side of the leg and thigh. Branching is in the central direction, in the form of the letter Y. Unlike arteries and veins, lymphatics do not change in diameter after bifurcation. Normally, retrograde filling is not observed.

Fig. 7. Inguinal lymph node with many afferent lymph channels and a single efferent vessel. Detail of Fig. 3, original size.

A typical feature is the small capacity of the vessels. Only about 1 to 4 ml. of contrast medium can be taken up, depending upon the number of vessels being filled. On account of the narrow lumen of the vessel and the density of the contrast medium, the injection is made slowly, under high pressure; generally half a minute to two minutes is required. The move-

ment of the medium may be followed subjectively by the burning sensation in the leg and thigh.

Funaoka and his collaborators (34) have found in their experimental studies that contrast material tends to remain at the site of injection for a considerable time if

Fig. 8. Normal lymph valves. Detail of Fig. 2, original size.

the animal is kept immobile, while active or passive motion promotes movement of the medium. We have made similar observations in man. However, immediately after the injection, permeation through the wall of the vessel into the surrounding area begins. Consequently the sharp lymphatic outlines disappear in a few moments; the vessels appear to thicken, and after five to ten minutes the medium is visible as a nebulous shadow surrounding the vessel.

Fig. 9. Normal lymph vessels. The lymphangiogram on the right side was obtained immediately after injection of the contrast medium; that on the left five minutes after the injection. In this latter view the contrast medium is seen to be permeating into the surrounding lymphatics.

This is well illustrated in Figure 9, a roentgenogram obtained during injection on the right side five minutes following injection on the left. For this reason, it is important always to indicate the time which has elapsed between the introduction of the medium and the obtaining of the film. Neglect of this detail may result in errors of diagnosis. The film made during the course of injection affords the most accurate information.

LYMPHEDEMA

Lymphedema as a result either of a congenital or acquired disease of the lymphatics may result in serious disturbance of lymph circulation. Since the lymph vessels are dilated, lymphography can be performed with relative ease, in exceptional cases even by percutaneous puncture. The

lymphatic lesions may be recognizable by the naked eye, but, again, it may be that on the dorsum of the leg the appearances are normal. The roentgenographic changes depend upon the characteristics of the lesion, its duration, and extent. In general the lymphatics appear thickened and tortuous, with intercommunications of the most various sorts. One sees lymphatics of different diameters simultaneously. Because of destruction or incompetence of the valves, retrograde filling is not unusual. In advanced disease there is a network of intertwined vessels in which the individual components cannot be distinguished. The capacity of the lymphatic system is increased, so that it can readily receive 20 to 50 ml. of the medium. It may happen, as in Case V, described below, that the great quantity of medium penetrates into the dilated lymph trunks close to the injection site and fails to reach the higher levels.

The accompanying roentgenograms demonstrate the changes in a few cases of lymphedema. These cases are presented in the order of their severity.

CASE I: The roentgenogram from this case (Fig. 10) was made after the injection of 10 ml. of 70 per cent Joduron. The lymphatics, which belong to the medial group, show several branches. These are of irregular diameter, especially at the site of origin. The spindle-shaped areas correspond to the valves. The irregular bifurcation, looping, and slight retrograde filling, indicated by the arrow, characterize early involvement by lymphedema.

CASE II: On the roentgenogram obtained after injection of 8 ml. of 70 per cent Joduron (Fig. 11) there can be seen in the lower third of the leg a tortuous lymph vessel, which is thicker than normal, thinning out for a short distance directly below its bifurcation. Above this point the medial of the two branches turns at a right angle before continuing its upward course; it is thicker than the other branch and in general is representative of early lymphedema.

CASE III: The film (Fig. 12) obtained one minute following the injection of Triopac 400 (a preparation similar to Diodrast) demonstrates, in addition to the medial group of lymphatics, a thin lymph vessel on the lateral aspect of the leg. The medial lymphatics are considerably thicker than normal, their course is tortuous, and they bifurcate irregularly, crossing one another. At the point indicated by the arrow, a thick vessel is seen, terminating blindly, with retrograde filling. In the surrounding tissues a network of fine lymphatics is visible.

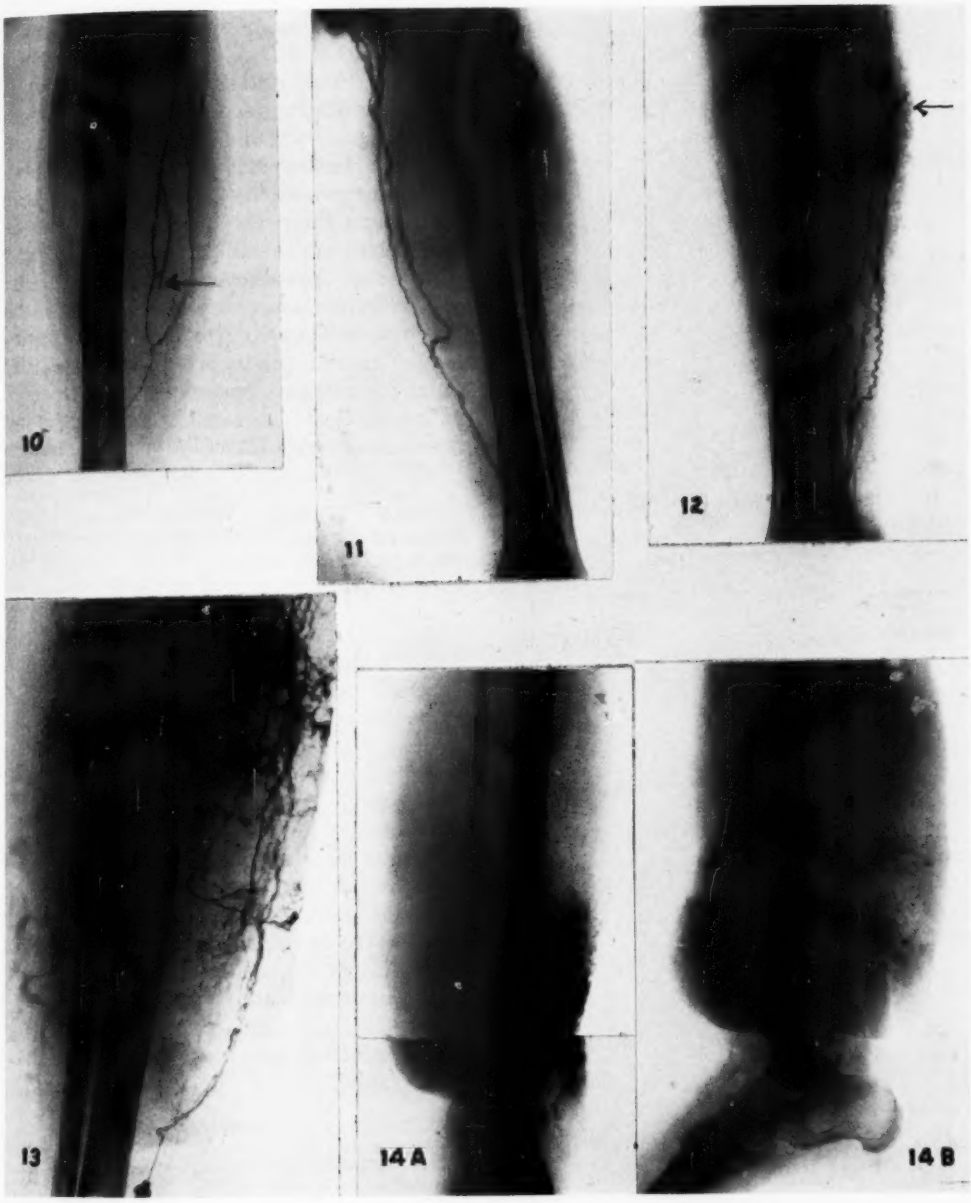
CASE IV: The lymphogram reproduced in Figure 13 was made one minute after the injection of 15 ml. of Joduron. The needle through which the medium was introduced is seen at the bottom of the picture. The normal lymphatic system cannot be recognized. Instead there is seen an irregular network of lymphatics, differing in diameter and communicating with one another at various points. Here and there retrograde filling has occurred in sections of larger or smaller lumen. At various points, round shadows of contrast medium are visible, representing lymphangiectasial vesicles on the skin. This case was diagnosed as lymphedema due to chylous reflux.

CASE V: As is seen in Figure 14, the medium in this case (25 ml. Triopac 400) did not get beyond the lower third of the leg. Distally the dilated, intertwined lymphatics are filled with the contrast material, producing a diffuse shadow in which the individual vessels are no longer identifiable. Above this, irregular lymph vessels of different diameters are visible, around which, particularly in the medial area, is a dense network of very fine vessels (Fig. 14A). A lateral view obtained five minutes later (Fig. 14B) demonstrates the marked swelling of the leg. The contrast material is still visible in spots. On the dorsum of the foot, a vague shadow of the vessel into which the medium was injected can be seen (Fig. 14B).

This series of roentgenograms (Figs. 10–14) shows how progressive changes in the lymphatics can be followed in cases of lymphedema.

CHRONIC VENOUS INSUFFICIENCY

In the presence of thrombophlebitis there is always an associated disturbance of the lymphatic circulation. When the iliofemoral vein is involved, edema of the lower extremity will occur. Leriche (35) and Ochsner and DeBakey (36) attribute the vasomotor and sympathetic features to the edema. Rusznyák, Földi, and Szabó (37) explained the occurrence of edema in the acute stage of iliofemoral thrombophlebitis as due to reflex lymph spasm, which hinders resorption of fluid and crystalloids from the tissues. A different situation exists in chronic venous insufficiency, since here organic lesions appear in the lymphatics. There are various reasons



Figs. 10–14. Lymphedema

Fig. 10. Case I. An early stage of lymphedema. The arrow indicates a site of retrograde filling
Figs. 11 and 12. Cases II and III, respectively.
Fig. 13. Case IV. Lymphedema from reflux of intestinal chyle into the leg.
Fig. 14. Case V. Anteroposterior (A) and lateral (B) lymphangiograms in an advanced stage of lymphedema.

to account for this. The chronic edema may itself be responsible, causing obstruction of the vessels through organization of the protein-rich edema fluid. In addition, thrombotic and fibrotic lesions of the lymph channels may be the result of repeated epi-

Fig. 15. Case VI. Lymphangiogram of a patient with chronic venous insufficiency.

sodes of phlebitis, lymphangiitis, and cellulitis (Leriche, 35; Homans, 38; Zimmerman, 39; Veal and Hussey, 40; Kramer, 41; Allen, Barker, and Hines, 42).

These observations are confirmed by our studies. In the acute stage of thrombophlebitis normal lymphatics have been found. In the presence of chronic venous insufficiency, on the other hand, we have shown the vessels to be tortuous, irregular in diameter, and greatly increased in number, especially in the thigh. Their capacity is also greater than normal, so that 10 to 15 ml. of contrast material can be injected without effort. A similar experience has been reported by Kaindl and his collaborators (31).

CASE VI: Figure 15 is a reproduction of a phlebogram from a patient with chronic venous insufficiency. The lateral vessels, especially in the thigh, are seen to be tortuous, irregular, and very numerous.

COMMENT

Lymphangiography differs from other vascular roentgenographic procedures in that the contrast medium remains for a relatively long interval in contact with the endothelial lining of the vessel, as much as fifteen to thirty minutes. For this reason a medium is required which will not exert any injurious effect on the endothelium. We have found 70 per cent Joduron and Triopac 400 (manufactured by Cilag, Schaffhausen) to meet this requirement. The procedure is not a simple one. It requires great patience and meticulous care, with particular attention to asepsis. The close cooperation of the radiologist is of vital importance.

SUMMARY

Lymphangiography is a relatively new diagnostic procedure affording data of great value concerning the lymphatic circulation of the limbs and organic lesions of the lymphatic vessels. In cases of chronic edema of the extremities the information thus obtained is of great diagnostic, prognostic, and therapeutic value.

The development of the procedure

through experimental studies has been traced, and the clinical applications are considered. Indirect lymphangiography has been found to be applicable only in animals. For studies in man, direct introduction of the contrast medium into the lymphatics appears to be necessary. The technic described by Kinmonth and Taylor has been used by the author in over 60 cases to demonstrate normal lymphatics and the disturbances associated with lymphedema and chronic venous insufficiency.

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SUMMARIO IN INTERLINGUA

Le Examine Roentgenographic Del Lymphaticos In Humanos

Lymphangiographia es un relativemente recente methodo diagnostic que produce datos de grande valor con respecto al circulation lymphatic in le extremitates e con respecto a lesiones organic in le lymphaticos. In casos de edema chronic in le extremitates, le information assi obtenite es de valor diagnostic, prognostic, e therapeutic. Le disveloppamento del technica e su applicationes clinic es considerate.

Ha essite trovate que lymphangiographia indirecte es applicabile solmente a animales. In studiar subjectos human, le introduction directe del substantia de contrasto a in le lymphaticos pare esser necessari. La technica de Kinmonth e Taylor esseva usate per le autor in plus que 60 casos pro demonstrar lymphaticos normal e le disturbationes associate con lymphedema e insufficientia venose.

Roentgenologic Changes of the Skeletal System in Cushing's Syndrome

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ALTHOUGH MANY articles have been written about the clinical features, pathology, and pathologic physiology of Cushing's syndrome, only two reports have dealt primarily with the roentgenographic aspects (1, 2). These and other studies have indicated that the most characteristic skeletal roentgenographic findings are osteoporosis and attendant fractures, without features peculiar to Cushing's syndrome. The present report was stimulated by an impression obtained by one of the authors (Pugh) that the spinal osteoporosis in this syndrome frequently is accompanied by an unusual condensation of the margins of some of the collapsed vertebral bodies of a degree seldom seen in other forms of osteoporosis.

From a physiologic standpoint, the osteoporosis of Cushing's syndrome and most of its other clinical and laboratory features (abnormal distribution of fat, muscular wasting and weakness, hypertension, amenorrhea, impotence, cutaneous atrophy and striation, easy bruising, hirsutism, acne, lymphopenia, eosinopenia, metabolic alkalosis, and impaired carbohydrate tolerance) are attributable to the metabolic effects of hydrocortisone-like steroid hormones that are produced in excessive amounts by hyperplastic or neoplastic adrenal cortices. In the case of bone, such steroids, through a catabolic or an anti-anabolic effect (3–6), or both, induce a loss of protein matrix, so that formation of bone is diminished and osteoporosis results.

MATERIALS AND METHODS

The case records and roentgenograms of 141 patients with the clinical diagnosis of Cushing's syndrome established at the Mayo Clinic during the years 1947–1955 were reviewed. Since compressed vertebral bodies were the subject of special interest, only the 69 cases in which lateral views of the spinal column were available were subjected to complete analysis. Post-treatment roentgenograms (with a minimal interval of six months after adrenalectomy or removal of an adrenal cortical tumor) had been taken in 19 instances, and there were complete oral roentgenograms for 6 patients.

As a control, to aid in the determination of the differential roentgenologic features, the records and roentgenograms of 50 patients with severe generalized osteoporosis due to other causes were reviewed. Only severe cases were included, since it was considered that any roentgenographic features present in mild or moderate osteoporosis would be accentuated in more severe states. The control patients were taken at random from persons examined at the clinic during 1956, the only criteria for selection being a clinical and roentgenographic diagnosis of severe osteoporosis and absence of any malignant condition.

CLINICAL AND PATHOLOGIC FINDINGS

Cushing's Syndrome: The 69 patients included 19 males and 50 females. The average age at the time of diagnosis was 36.4 years, the youngest patient being thirteen years of age and the oldest sixty years. The average time from the onset of symptoms to our initial examination, which included the roentgenograms we studied,

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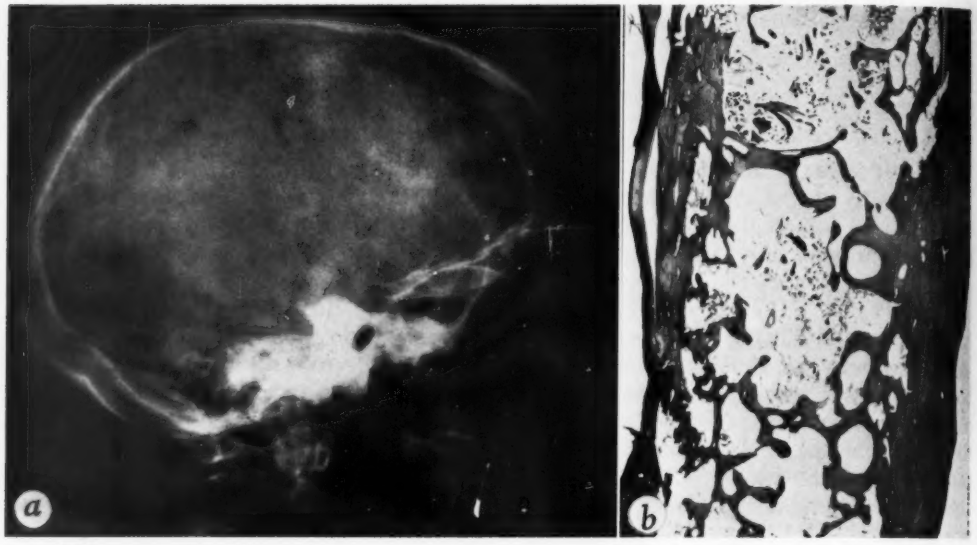

Fig. 1. *a*. Skull showing zones giving the appearance of osteolysis. The patient was a 35-year-old woman with onset of symptoms approximately three years prior to examination. Bilateral adrenal cortical hyperplasia was found at operation. *b*. Microscopic appearance of same skull, showing osteoporosis. Hematoxylin and eosin; ×12.

was 3.1 years. All but one of the 69 patients were treated by total or subtotal adrenalectomy or by excision of an adrenal cortical tumor. Microscopically, the excised adrenal tissue showed hyperplasia in 57 cases, adenoma (single or multiple) in 9 cases, and carcinoma in 3. In the consideration of the pathologic status of excised non-neoplastic adrenal tissue, we have followed the terminology of Sprague and associates (7), who designated as "adrenal cortical hyperplasia" such hyperfunctioning adrenal glands as were not the site of tumor. These glands in some instances were of normal weight, and definite cytologic evidence of hyperplasia was not demonstrated; however, unequivocal clinical and laboratory evidence of hyperfunction was present.

The clinical, surgical, and pathologic features of most of these cases have been included in previous reports (3, 7, 8).

Control Series: In none of the 50 control cases of severe osteoporosis of the spinal column was there clinical evidence of malignancy, a history of administration of cortisone or corticotropin (ACTH), or clinical signs of Cushing's syndrome. The average age of these patients was 71.2 years. Six were males and 44 females. The clinical diagnosis was postmenopausal osteoporosis in 25 cases, senile osteoporosis in 21 cases, and idiopathic osteoporosis in 2. The osteoporosis in the remaining 2 patients was considered to be caused by prolonged rest in bed because of a disabling condition; one was a severe diabetic with complications following cholecystectomy, and the other was almost totally paralyzed owing to injury to the cervical portion of the spinal cord.

ROENTGENOLOGIC FINDINGS

Cushing's Syndrome: Roentgenograms of the *skull* were available for 43 of the 69 patients with Cushing's syndrome. Of these, 41 showed evidence of osteoporosis, which was of moderate or severe degree in all but 4. The osteoporosis was manifested by diffuse decalcification in 25 patients, while the other 18 showed the peculiar "metastatic-appearing" type of decalcification first described by Sussman and Copleman (1). This latter

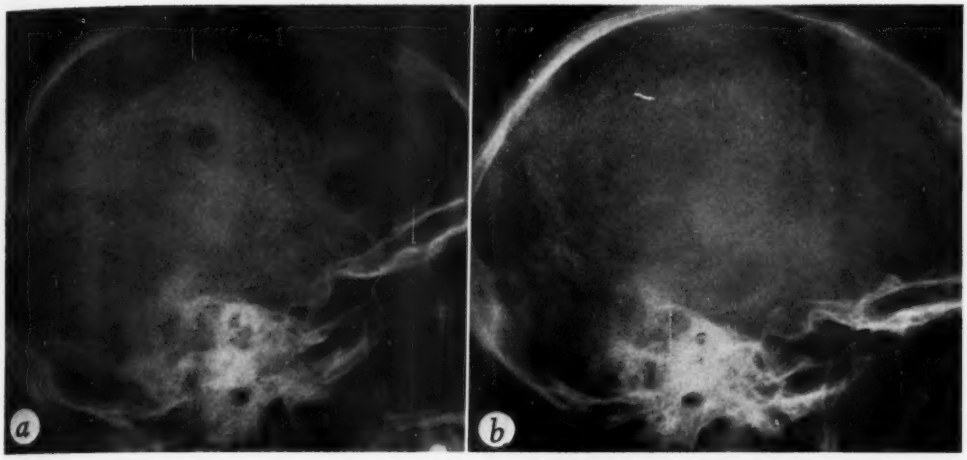

Fig. 2. Skull roentgenograms of a 39-year-old woman with Cushing's syndrome of seven years duration. *a*. Pretreatment roentgenogram, showing a circumscribed radiolucent zone in the midparietal region. *b*. Roentgenogram made eighteen months after bilateral subtotal adrenalectomy for cortical hyperplasia. The parietal rarefied zone has almost disappeared.

change consisted in irregular zones of rarefaction separated by bone of relatively normal appearance. The irregular decalcification was most evident in the frontal and parietal regions but was occasionally seen throughout the skull (Fig. 1, *a*). Biopsy of one such rarefied zone showed only osteoporotic bone (Fig. 1, *b*). No attempt was made to evaluate the lamina dura as seen in the skull roentgenograms; it could be identified, however, in each of the 6 cases with complete oral roentgenograms.

Post-treatment skull roentgenograms of 11 patients in clinical remission for more than six months were available. Three of these showed no change in the osteoporosis, whereas in 6 cases it had improved and in 2 it had disappeared. Metastatic-appearing areas had recalcified in 3 instances (Fig. 2).

Seven of the 43 skull roentgenograms displayed enlargement and erosion of the sella. In addition, there were a number of instances of decalcification of the sella, which was considered to be part of the cranial osteoporosis. The pituitary gland of one patient whose sella was enlarged and eroded was studied microscopically, disclosing an atypical adenoma composed of cells without basophilic granules. In all 7 patients, operation revealed adrenal cortical hyperplasia.

Thoracic roentgenograms of 55 patients were available. In all but one, osteoporosis of the ribs, of varying degrees, was present. Fractures of the ribs were frequent; among the 32 patients with such fractures, the average number per patient was 6.2 (Fig. 3, *a*). The reparative callus was usually heavy. The fractures did not resemble pseudofractures. Three patients had broadening of the anterior costochondral junction that had a roentgenographic appearance similar to that of fracture callus. Only three of the 32 patients gave histories of chest pain.

All but 2 of 68 roentgenograms of the *pelvis* showed osteoporosis. The decalcification was of about the same degree as that in the lumbar portion of the spinal column. Six patients had fractures of the pubic or ischial rami; in all of these, heavy callus formation was present (Fig. 3, *b*). Roentgenologically, these lesions did not resemble pseudofractures. None of these patients gave a history of pain in the pelvic region.

Roentgenograms of the *extremities* of 11 patients were available. Six of these did not show osteoporosis, 4 displayed osteoporosis of mild or moderate degree, and 1

Fig. 3. *a*. Thorax in which 25 separate rib fractures could be identified. Note the heavy callus. The patient was a 40-year-old woman with Cushing's syndrome of approximately seven years duration. Complaint of thoracic pain was not recorded. *b*. Bilateral pubic fractures in a 25-year-old woman with Cushing's syndrome of three years duration; no history of trauma or pelvic pain.

gave evidence of osteoporosis of the left humerus but not of the feet or ankles. One patient had a pathologic fracture of the right tibia secondary to moderate osteoporosis in this region. This was her presenting complaint. There was one instance of Kienböck's osteochondrosis of the right semilunar bone. Fractures of the femur were not observed in this series. Of the 2 patients in whom Cushing's syndrome occurred during the period of growth, one showed normal bone age and the other showed a two-year delay; in the latter patient, the chronologic age was seventeen years and the bone age was fifteen years.

An analysis of the *spinal roentgenograms* of the 69 patients is shown in the accompanying table. Marginal condensation of the vertebral bodies (Fig. 4, *a*) was present in 29 of the entire series of 69 cases (42 per cent); this gives an incidence of 53 per cent in the 55 cases in which moderate or severe osteoporosis was present, since compression and condensation occurred only when the osteoporosis was more than minimal. The lower thoracic and upper lumbar regions were affected most frequently. Condensation was seen in both the lumbar and thoracic regions in 11 patients. In no instance was there a condensation or compression fracture in the cervical part of the spinal column.

An average of 3.6 vertebral bodies were affected in the 29 patients with marginal vertebral condensation. The condensation usually occurred along the upper margins of the vertebrae, but occasionally it was seen along the lower margins. Although it ordinarily was associated with readily apparent compression of the vertebral body, in a few instances this was minimal and its recognition was difficult. The average number of compressed vertebral bodies per patient was 4.7 among the 33 patients exhibiting compression fractures.

All but 5 of the 33 patients who had compression fractures complained of pain

TABLE I: ANALYSIS OF SPINAL ROENTGENOGRAMS OF 69 PATIENTS WITH CUSHING'S SYNDROME

Osteoporosis	Number of Cases	Average Age (Years)	Average Duration of Symptoms (Years)	Cases with Compression Fractures		Cases with Marginal Condensation	
				Thoracic	Lumbar	Thoracic	Lumbar
Absent	1 (1.5%)	32.0	2.4	0	0	0	0
Slight	13 (18.8%)	39.6	1.7	0	0	0	0
Moderate	26 (37.7%)	35.8	3.9	7	5	5	5
Severe	29 (42.0%)	35.3	3.4	19	15	18	12
Total or average	69 (100.0%)	36.4	3.1	26	20	23	17

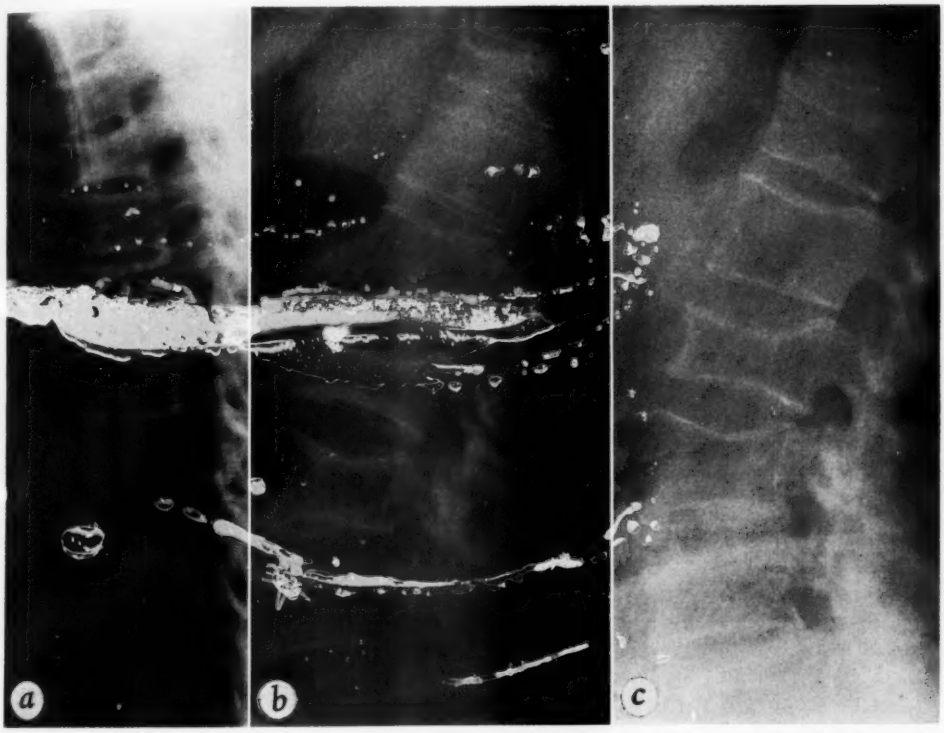

Fig. 4. *a*. Marginal condensation is present in most of these thoracic vertebrae. The patient, a 49-year-old woman, had symptoms of adrenal cortical hyperfunction for four years. She did not complain of pain in the back. *b*. Roentgenogram of another patient. Note marginal condensation of the second and third lumbar vertebrae. *c*. Same case as *b*, ten months later. Condensation has disappeared in the nine months since treatment.

in the back. In only 1 case of severe osteoporosis without radiographically demonstrable compression was there a complaint of back pain. Two patients who had marginal condensation of a vertebral body but only minimal loss of height of this or other bodies were without pain in this region. As already intimated, the 33 patients with compression fractures included all 29 who had condensation of one or more vertebral bodies, an incidence of 88 per cent.

Post-treatment (more than six months) spinal roentgenograms of 19 patients were available. All but one of this group showed clinical remission of the signs and symptoms of Cushing's syndrome. Eight showed a significant decrease in the degree of osteoporosis, but in no instance had it disappeared completely. In 8 of the patients with post-treatment roentgenograms, pretreatment studies showed condensation. In 2, this had not changed; it had decreased in 3 and had disappeared completely in the other 3.

Figure 4, *b* and *c*, illustrates disappearance of marginal condensation. The patient was a forty-eight-year-old man who had first exhibited symptoms referable to adrenal cortical hyperfunction in July 1947. Roentgenograms of the spinal column in February 1948, about seven months after the onset of symptoms, showed severe osteoporosis, compression of five thoracic and four lumbar vertebrae, and marginal condensation of two lumbar vertebrae (Fig. 4, *b*). At operation, in March 1948, bilateral hyperplasia of the adrenal cortices was found and bilateral total adrenalectomy was done, followed by satisfactory

Fig. 5. Spinal roentgenogram of a 57-year-old woman with postmenopausal osteoporosis. Note the shadow of the intestine superimposed on the fourth lumbar vertebra, which simulates condensation. Also note the accentuated cortices of the vertebral bodies; this occurs frequently in osteoporosis and should not be confused with condensation.

remission of the clinical features of Cushing's syndrome. A post-treatment roentgenogram in December 1948 showed no change in the osteoporosis (there was a slight difference in technical factors) or compression, but the condensation had disappeared (Fig. 4, *c*).

In the other 5 cases, also, in which condensation was present and follow-up roentgenograms showed improvement, it was noted that the condensation diminished or disappeared before any change in the osteoporosis was demonstrable roentgenographically.

Control Group: Roentgenograms of the *skull* were available in only 5 of the control group of 50 patients with osteoporosis not associated with Cushing's syndrome. Osteoporosis was present in 3 of these cases, being severe in 2 and moderate in 1.

Roentgen studies of the *thorax* were available in 40 of the control group. The ribs showed severe osteoporosis in every instance. In 2 patients in whom rib fractures were seen, the roentgenographically visible callus was normal; both these patients gave histories of trauma and thoracic pain.

Roentgenograms of the *pelvis* showed severe osteoporosis in all of the 46 patients in whom this view was available. No fractures were demonstrated in this region.

Four patients had recent or ancient fractures of the upper portion of the *femur;* severe osteoporosis was present in this region in each instance. In addition, 1 patient had a fracture of the medial malleolus of the left *ankle* associated with severe generalized osteoporosis. This injury occurred after a prolonged period of rest in bed for an intertrochanteric fracture of the femur of the same leg.

The *spinal roentgenograms* of these 50 control patients were subjected to careful analysis. Compression fractures of one or more vertebral bodies, chiefly in the lower thoracic and upper lumbar regions, were present in 46, the average number of compressed vertebral bodies per patient being 3.8. All but 2 gave histories of present or past pain in the back. Condensation of vertebral bodies was seen in a single instance. This patient, a seventy-five-year-old woman with senile osteoporosis, had minimal condensation of two lumbar vertebral bodies. She gave a history of pain in the back of one month duration, but the clinical picture was not significantly different in any respect from that observed in the other members of the group.

In a number of instances, superimposed objects gave an appearance to the vertebral body similar to that of condensation. Overlying loops of intestine, rib shadows, and the upper edge of the ilium were the most frequent offenders (Fig. 5). All these images, however, could be traced outside the vertebral body and thus be explained.

COMMENT

The principal criterion for the diagnosis and grading of osteoporosis in this study was the degree of alteration of trabecular structure. Diminution of density, with proper allowance for technical factors, also was considered. In the spinal column, ballooning of the intervertebral disks was another factor.

The incidence of osteoporosis in this series was greater than in previously reported studies of Cushing's syndrome. However, as noted previously, only patients for whom spinal roentgenograms were available were included in the review, and the apparently greater incidence may be due to the fact that roentgen studies of the spine were made more often when the condition was clinically further advanced. Of the 69 patients in the series, 29 complained of pain in the back that stimulated the clinician to obtain roentgenograms of the spine. This complaint in itself may be suggestive of moderate or severe osteoporosis (9). In some instances, roentgenograms that were originally interpreted as normal had been discarded; therefore, these patients were not included in the study. In view of the fact that availability of spinal roentgenograms was the basis of selection, no effort has been made to express the percentage incidence of roentgenographic findings for any other region.

The distribution of the osteoporosis of Cushing's syndrome found in this study (principally the ribs, spinal column, and pelvis) was the same as that reported for osteoporosis associated with other conditions, except that the skull was more frequently involved in Cushing's syndrome. It appears likely that this is the only condition in which a high incidence of cranial osteoporosis occurs. Our series of skull roentgenograms of patients with osteoporosis due to other causes is too small, however, to permit adequate comparison.

The cranial demineralization noted in some patients had certain similarities to that seen in hyperparathyroidism. This was particularly true of the cases showing a diffuse granular rarefaction, as previously noted by Sussman and Copleman (1) and by Wang and Robbins (2). The other type of decalcification, in which larger zones of localized hypomineralization are separated by more normal-appearing bone, confirmed the impression of Sussman and Copleman of a "metastatic-cancer appearance." The fact that this picture can be confused with that of osteolytic metastatic lesions is illustrated in this study by one case in which a biopsy was deemed necessary to exclude the presence of a malignant tumor.

The incidence of sellar enlargement was greater in this series (7 of 43) than in others previously reported. In the group studied by Plotz and associates (10), the incidence was 3 per cent; Sussman and Copleman did not mention sellar enlargement, and Wang and Robbins found only 1 instance of a questionably enlarged sella among 38 cases. Other reports mention sellar enlargement only to state that it is extremely rare.

The degree of osteoporosis and the incidence of rib fractures in this study were similar to those reported previously in Cushing's syndrome. The unusually abundant reparative callus about these fractures was noted previously by Sosman (11) and by Wang and Robbins. It appears that fractures of the ribs occur more frequently in Cushing's syndrome than in osteoporosis due to other causes. We found no reference to large amounts of callus about rib fractures in other conditions, nor did we see this in the control series. Dent (12) pointed out that the frequent rib fractures in idiopathic osteoporosis heal with minimal callus. The occasional painless nature of the fractures in Cushing's syndrome was noted by Strickland (13). It is noteworthy that only 3 of 32 patients with rib fractures in the present study complained of thoracic pain.

Fractures of the pelvis associated with the osteoporosis of Cushing's syndrome were an unexpected finding. One example of a pathologic fracture of the pubis was reported by Strickland. That author con-

sidered that fractures were more common than osteoporosis, but pelvic fractures in our series occurred only in the presence of moderate or severe osteoporosis. As already mentioned, these fractures did not resemble pseudofractures. Their painless nature is an observation not previously reported.

Our findings in a small number of roentgenograms of the extremities were in agreement with previous reports; osteoporosis was either absent or not so severe as in the axial skeleton. Moderate generalized osteoporosis was present in the patient who had a fracture of the tibia. We found no instances of pathologic fracture in the absence of osteoporosis.

Osteoporosis of the spinal column, as evidenced by increased radiolucency of bone, alteration of trabecular structure and expansion of the intervertebral disks producing biconcave vertebrae, was seen in higher incidence and generally to a more severe degree in this series than in previously reported studies of Cushing's syndrome, owing in part to the method of selection of films for study, as already indicated. It was noted that the cancellous portions of the rarefied bodies were more affected than were the cortical portions, a point that has been noted in other types of osteoporosis by Dent (12) and others (14, 15).

In agreement with the findings of Black and co-workers (9) in their patients with senile osteoporosis, we noted a direct correlation between vertebral compression fractures and the degree of spinal osteoporosis. As in the senile cases as well as our own control group, the compression fractures secondary to the osteoporosis of Cushing's syndrome occurred principally in the lower thoracic and upper lumbar regions.

This study revealed instances of improvement of the osteoporosis of Cushing's syndrome after successful surgical treatment, a point that has been questioned by others (2). Improvement or disappearance of the osteoporosis of the skull was seen in 8 patients, and a decrease in the degree of spinal osteoporosis was noted in an equal number.

Marginal condensation of vertebral bodies in association with compression fractures has not been described hitherto in Cushing's syndrome or in any other form of osteoporosis. After perusing the literature, studying the published roentgenograms, and reviewing our films of patients with osteoporosis associated with various other diseases, we consider that marginal condensation can occur in conditions other than Cushing's syndrome but that it is minimal and rare. Slight condensation was seen in only 1 of our 50 control patients. In previous reports of Cushing's syndrome, the roentgenograms show marginal condensation, but attention has not been called to this finding. This is particularly evident in the report of Sussman and Copleman and in Epstein's textbook (16), in which the phenomenon is ascribed to compression of bone.

The term "marginal condensation" was decided on as most descriptive of the radiopacity in the vertebral bodies, since the increased density appears roentgenographically to involve both the cortical and subcortical portions. The pathologic basis for vertebral marginal condensation is well shown in Sissons' study (17), although he did not call attention specifically to this finding; roentgenograms of the spinal column and of bone slabs in his Cases 3 and 4 reveal condensation of the margins of several vertebrae. Photomicrographs of collapsed portions show that slender trabeculae in this area have become impacted and surrounded by newly formed bone to produce a thicker structure.

The pathologic studies of healing of fractures reported by Follis (18) and by Sissons indicate an interference by the corticosteroids with such healing, which probably is analogous to their interference with healing of wounds in general. The callus produced evidently does not give normal strength to the site of the fractures; these fractures are not so painful as fractures normally are, owing to an analgesic effect of the adrenal steroids. For this reason the

part is not splinted as much as it normally would be. Consequently, there is a continued strong stimulus for the production of osteoid. The osteoid becomes calcified and thus is visible roentgenographically. This may be the explanation for the unusually heavy callus about fractures of the ribs and pelvis and the marginal condensation of vertebral bodies.

SUMMARY AND CONCLUSIONS

A study was made at the Mayo Clinic of 69 patients with Cushing's syndrome in whom lateral spinal roentgenograms were available. Roentgenologic evidence of osteoporosis was present in 68 of the 69 patients. This osteoporosis was of approximately equal severity in the spinal column, pelvis, and ribs. Osteoporosis of the extremities was less severe and was occasionally absent. About 40 per cent of the skull roentgenograms showed an irregular, "metastatic" type of decalcification. Sellar enlargement was present in 7 of 43 cases. Decreased osteoporosis of the skull associated with clinical remission after adrenalectomy was seen in 8 of 13 cases. Two-thirds of the 69 patients had rib fractures and 6 had pelvic fractures, but rarely was a patient aware of these.

Marginal condensation of multiple vertebral bodies associated with compression fractures occurred in 29 patients (42 per cent of all patients and 55 per cent of those with moderate or severe osteoporosis). This involved principally the lower thoracic and upper lumbar regions. In 8 of 18 cases, roentgenograms made after remission showed improvement in the spinal osteoporosis. For 8 patients whose spinal roentgenograms showed marginal condensation, post-treatment roentgenograms were available; the condensation had decreased or disappeared in 6 of these. The disappearance of zones of condensation may be the first roentgenographic sign of improvement of the disordered osseous metabolism.

A review of the records and roentgenograms in 50 control patients who had severe osteoporosis not associated with Cushing's syndrome did not disclose any painless fractures or abnormal fracture callus. There was only one instance of minimal marginal condensation of a vertebral body.

Marginal condensation of vertebral bodies may thus be said to be frequently associated with vertebral fractures in Cushing's syndrome but rarely seen in other forms of osteoporosis. The finding of multiple painless fractures of ribs and pelvis appears to be a differential feature of this disease.

Vertebral condensation and abnormally large fracture callus in the ribs and pelvis reflect the abnormal healing of fractures of osteoporotic bone in Cushing's syndrome. These features and the osteoporosis itself improve in a significant proportion of cases when adrenal cortical secretions are decreased by adrenalectomy or excision of an adrenal cortical tumor.

Vertebral compression with marginal condensation or painless fractures of the ribs or pelvis should suggest the possibility of Cushing's syndrome.

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SUMMARIO IN INTERLINGUA

Alterationes Roentgenologic Del Systema Skeletic In Syndrome De Cushing

Esseva effectuate un studio de 69 patientes con syndrome de Cushing inqui roentgenogrammas latero-spinal esseva disponibile. Osteoporosis esseva roentgenologicamente evidente in 68 del 69 patientes. Le osteoporosis esseva de approximativemente le mesme grado de severitate in le columna vertebral, le pelve, e le costas. Osteoporosis del extremitates esseva minus sever e a vices absente. Circa 40 pro cento del roentgenogrammas cranial exhibiva un typo irregular e "metastatic" de discalcification. Allargamento sellar esseva presente in 7 ex 43 casos. Reducite grados de osteoporosis del cranio in association con remission clinic post adrenalectomia esseva notate in 8 ex 13 casos. Duo tertios del 69 patientes habeva fracturas costal, e 6 habeva fracturas pelvic. In le majoritate del casos le patiente non esseva conscie del presentia de tal fracturas.

Condensation marginal de multiple corpores vertebral associate con fracturas de compression occurreva in 29 casos (i.e. in 42 pro cento del gruppo total e in 55 pro cento del patientes con moderate o sever grados de osteoporosis). Isto afficeva principalmente le regiones infero-thoracic e supero-lumbar. In 8 ex 18 casos, roentgenogrammas post-remissional demonstrava melioration del osteoporosis del columna vertebral. In le casos de 8 patientes, in qui le roentgenogrammas spinal exhibiva condensation marginal, roentgenogrammas post-tractamental esseva disponibile. Le condensation esseva reducite o habeva disparite in 6 de illes. Le disparition de zonas de condensation es possibilemente le prime signo roentgenologic de un melioration del disturbate metabolismo ossee.

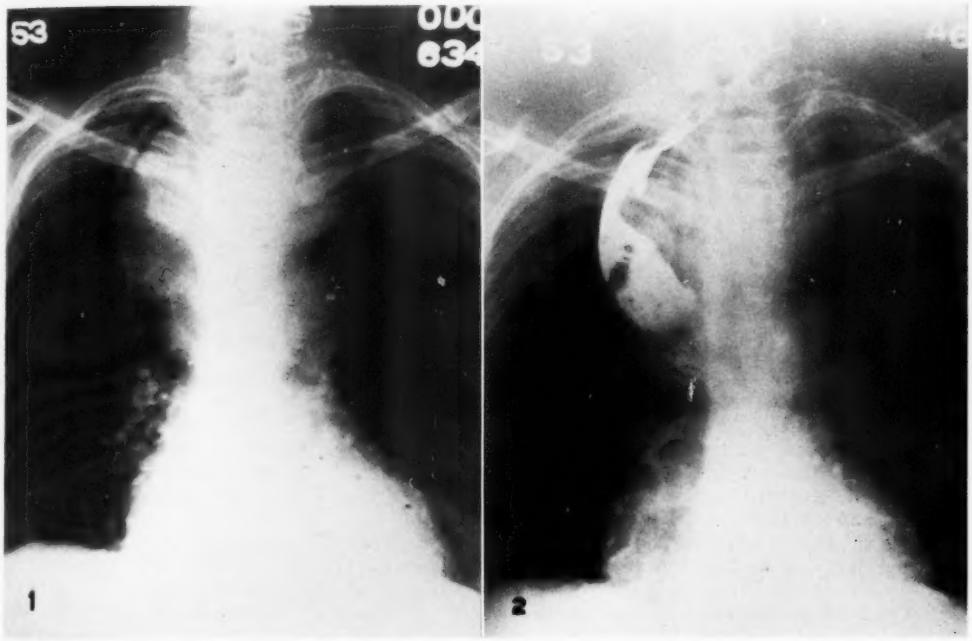
Un revista del dossiers e del roentgenogrammas de 50 patientes de controlo qui habeva sever grados de osteoporosis non associate con syndrome de Cushing non monstrava ulle fractura indolorose o anormal callo fractural. Se trovava in iste serie non plus que un sol caso de grados minimal de condensation marginal de un corpore vertebral.

Assi on pote asserer que condensation marginal de corpores vertebral es frequentemente associate con fracturas vertebral in syndrome de Cushing sed que illo es rarmente incontrate in altere formas de osteoporosis.

Posterior Mediastinal Goiter[1]

JEROME H. SHAPIRO, M.D.,[2] HAROLD G. JACOBSON, M.D., F.A.C.R.[3], WILHELM Z. STERN, M.D.[4], and MAXWELL H. POPPEL, M.D., F.A.C.R.[5]

THE POSTERIOR mediastinum is an infrequent site for an enlarged thyroid. A correct preoperative diagnosis is required, so that the proper surgical approach may be used. Five cases of posterior mediastinal goiter will be presented and the current literature reviewed.



Figs. 1 and 2. Case I. 1. Postero-anterior roentgenogram of the chest showing a large superior mediastinal mass compressing the trachea and displacing it to the right.
2. Postero-anterior roentgenogram showing marked displacement of the barium-filled esophagus to the right, with a "stretching" effect.

CASE I: A 68-year-old white female was seen in 1953, with a history of a mass in the neck since 1914. In 1936, a subtotal thyroidectomy had been performed. A nonproductive cough persisted after the thyroidectomy and was associated with some exertional dyspnea and substernal wheezing. More recently, auricular fibrillation had developed. On roentgen examination of the chest in the postero-anterior postion (Fig. 1), a mediastinal mass was seen bilaterally, projecting more toward the right. The trachea was displaced to the right and compressed. A frontal plane film with barium (Fig. 2) showed the esophagus to be displaced to the right. On the oblique and lateral projections (Figs. 3 and 4) the trachea was bowed forward and the esophagus displaced posteriorly by the tumor lying between

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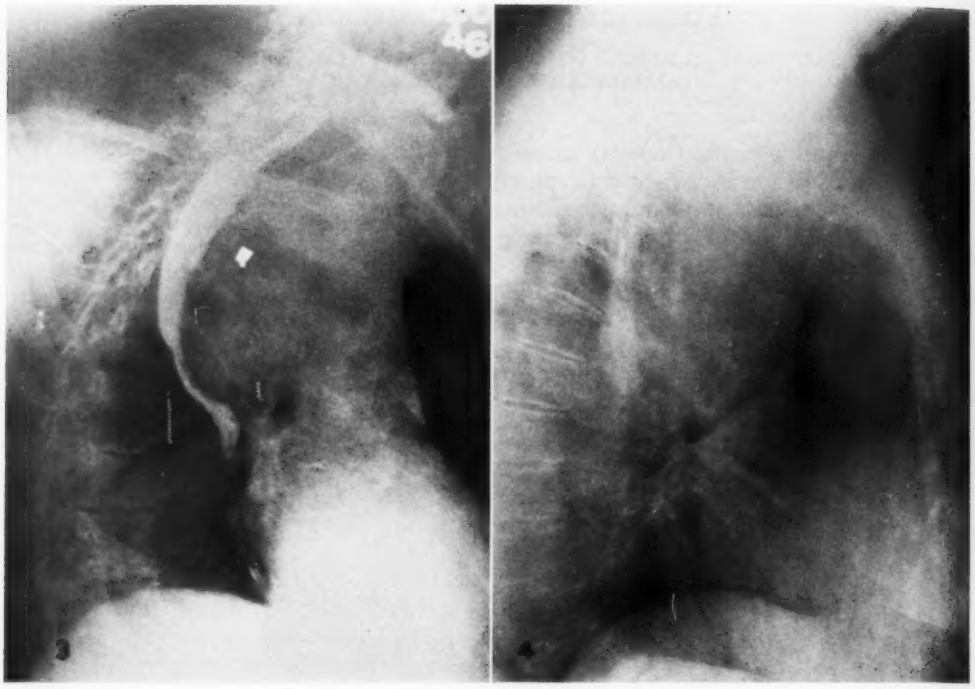


Figs. 3 and 4. Case I. 3. Right anterior oblique view of chest showing the barium-filled esophagus displaced posteriorly to a considerable extent.
4. Right lateral chest roentgenogram demonstrating forward displacement and bowing of trachea.

these two structures. At surgical exploration, a lobulated mass was observed extending from the thoracic inlet down to the hilus of the lung. The esophagus was stretched over the posterior aspect of the mass, and the trachea, which was bowed anteriorly, was caught between it and the sternum.

Examination by the Department of Pathology showed a mass 14 × 9 × 6 cm. which weighed 410 gm. The histologic diagnosis was *colloid adenoma of the thyroid gland.*

CASE II: A 46-year-old white male had a mediastinal mass density detected on a routine roentgenographic examination of the chest. The postero-anterior chest roentgenogram (Fig. 5) showed a bilateral mediastinal mass, somewhat asymmetrical, projecting to the right. The trachea and esophagus were slightly shifted to the right. The trachea was bowed anteriorly in the lateral projection (Fig. 6) and the barium-filled esophagus was also displaced forward. At operation, a spheroid mass pushing the esophagus forward was found in the posterior compartment of the superior mediastinum. "The mass was bordered posteriorly by the vertebral bodies of the dorsal spine, inferiorly by the azygos vein, anteriorly by the superior vena cava, and superiorly by the superior thoracic inlet."[6]

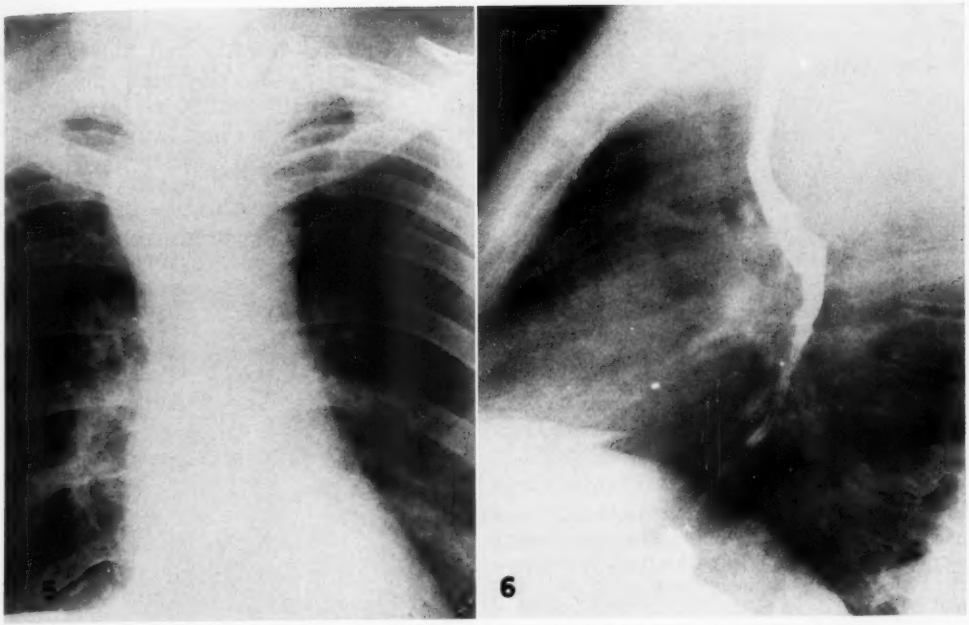
[6] Note by the operating surgeon.

The Department of Pathology reported a specimen which weighed 110 gm. and measured 9.5 × 7.5 × 4.5 cm. The histologic diagnosis was *macro- and microfollicular adenomas of the thyroid gland.*

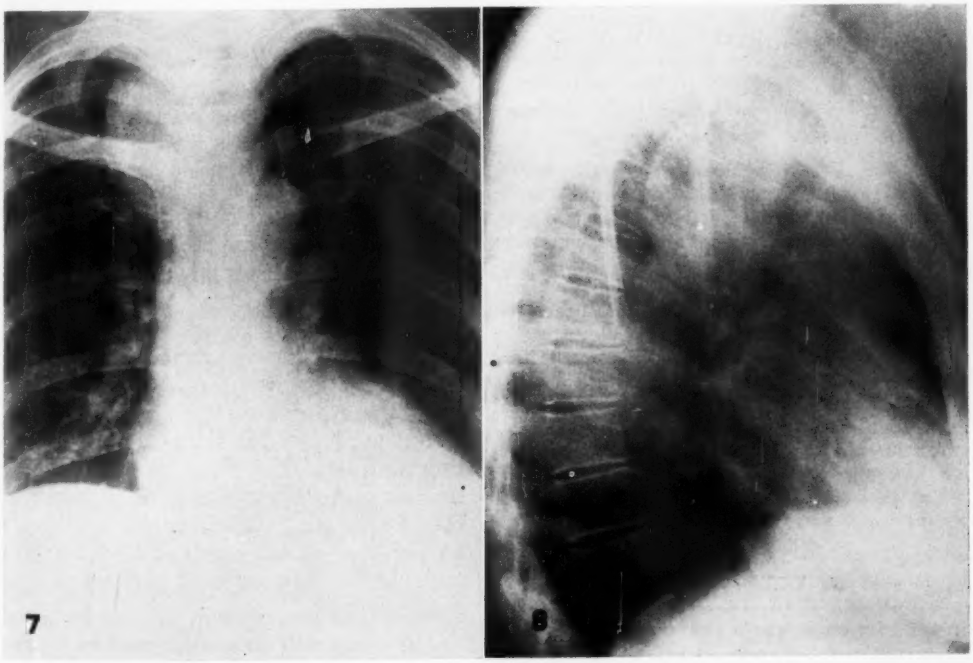
CASE III: A 58-year-old white female was admitted to the hospital with an established diagnosis of acute myelogenous leukemia. The past history indicated a thyroidectomy performed fourteen years earlier, for toxic goiter. A postero-anterior chest roentgenogram obtained shortly after admission (Fig. 7) revealed a superior mediastinal mass projecting toward the right, with deviation of the trachea to the left. A lateral film (Fig. 8) showed the mass to be located behind the trachea, with some anterior displacement of that structure. The patient died seven days after admission from her generalized systemic disease (leukemia).

At postmortem examination, the thyroid gland weighed 170 gm. and the left lobe was absent, due to the previous surgery. The right lobe was continuous with a soft lobular mass located on the lateral and posterior aspect of the trachea. The histologic diagnosis was *adenomatous hyperplasia of the thyroid.*

CASE IV: A 74-year-old white male complained of dysphagia of two years duration. Physical examination revealed enlarged lymph nodes in the right



Figs. 5 and 6. Case II. 5. Frontal plane chest roentgenogram showing large superior mediastinal mass.
6. Left lateral projection, showing barium-filled esophagus and the trachea bowed forward by a posteriorly situated mediastinal mass.



Figs. 7 and 8. Case III. 7. Frontal plane roentgenogram showing large superior mediastinal mass, mostly on the right, and displacement of the trachea to the left.
8. Right lateral view, showing displacement of trachea by large posteriorly situated mediastinal mass.

Fig. 9. Case IV. Frontal plane view showing large superior mediastinal mass. The aortic arch may be displaced laterally.

supraclavicular fossa. A right recurrent nerve paralysis was noted. A postero-anterior chest roentgenogram (Fig. 9) showed a mass in the superior mediastinum, beginning above the thoracic inlet and extending down to the level of the aortic arch, which was displaced slightly to the left. On the lateral film (Fig. 10) the tumor was seen to be partly behind the trachea and appeared to girdle that structure. There was no uptake of I^{131} by the intrathoracic tumor. Surgical exploration demonstrated a mass involving the right lobe of the thyroid, with inferior extension and adherence to the trachea and esophagus.

The histologic diagnosis was *anaplastic carcinoma of the thyroid gland.*

CASE V: A 28-year-old white male observed by one of us (M. H. P.) in 1945, during World War II, complained of gradually increasing dysphagia with fullness in the neck. Fluoroscopic examination showed a mediastinal mass compressing the esophagus and trachea at the level of the thyroid. In the lateral projection the mass was seen to be located between the trachea and the esophagus, displacing the trachea anteriorly and the esophagus posteriorly and somewhat laterally. Chest roentgenograms (not now available) confirmed these findings. A surgical exploration disclosed a thyroid mass growing between the esophagus and trachea and widely separating these structures.

The microscopic sections showed *benign adenomatous thyroid tissue.*

DISCUSSION

Enlargement of the thyroid gland most frequently occurs anteriorly and in a lateral direction. Such enlargement is limited by the "strap" muscles, and posterior growth is generally prevented by the cervical spine. Thus, the expansion may be downward toward and through the thoracic inlet. Gravity and movement of the gland with swallowing may be contributory factors in this downward growth. Further enlargement may fix the mass in the mediastinum.

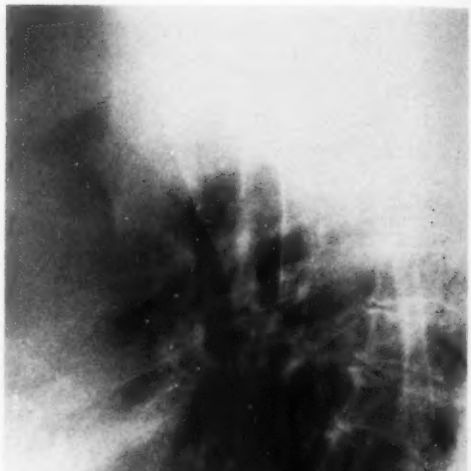


Fig. 10. Case IV. Left lateral chest roentgenogram showing superior mediastinal mass lying partially behind the trachea and partially superimposed upon it.

The term "intrathoracic goiter" is applied to an enlarged thyroid with the major portion in the thorax. It is to be distinguished from "substernal goiter," where the largest portion lies above the sternum and in the neck (1).[7] In a series of over 900 thyroidectomies, the incidence of intrathoracic goiter was found to be 3.1 per cent (2). Approximately one-third of such goiters are located in the posterior mediastinum, where they may lie between the trachea and the esophagus or posterior to the esophagus. Calcification occurs in 25 per cent of the cases and 84 per cent are said to show upward movement with swallowing (2).

[7] Lichtenstein *et al.* (3) have recommended the term "substernal retro-esophageal goiter" to replace posterior mediastinal goiter, but this use of "substernal" is confusing and describes only a single type of posterior mediastinal goiter.

Clinical Findings: In the series of intrathoracic goiters recorded by McCort (2) 71 per cent of the patients were over fifty years of age. Common findings were swelling of the neck, dyspnea on exertion, chronic cough, and dysphagia. Less frequent, but characteristic when present, were dyspnea on lying down and a choking sensation. These two symptoms were accentuated when the head was turned to the side of the goiter and were relieved when the patient assumed the upright position. Johnston *et al.* (4) observed three findings which would strongly support a diagnosis of intrathoracic goiter: (*a*) history of previous thyroidectomy; (*b*) presence of a nodular thyroid gland in the cervical region; (*c*) retroclavicular fullness.

Roentgen Diagnosis: The roentgen appearance of posterior mediastinal goiter is that of a homogeneous, well circumscribed density located behind the trachea and near the midline, but frequently with a predominant lateralizing asymmetry. Johnston has noted this asymmetry more frequently toward the right, a finding also observed in the present series. When the goiter is posterior to the esophagus, there are anterior displacement and bowing of the trachea and esophagus in addition to lateral deviation. When the goiter lies between the trachea and the esophagus (Cases I and V), these latter structures are displaced in opposite directions, the former anteriorly and the latter posteriorly. Some mediastinal goiters may present a problem in classification, being lateral and close to the plane of the trachea. In such instances, the location of the major portion of the mass should determine whether an anterior or posterior mediastinal goiter is present. Bucky roentgenograms of the superior mediastinum may demonstrate the reflection of the mediastinal pleura below the goiter and determine the mediastinal origin of the mass. The aortic arch may be depressed and displaced laterally (Case IV). The presence of calcification is helpful, and upward movement on deglutition may be considered almost diagnostic, although it should be mentioned that such movement may occur with enterogenous cysts. An intrathoracic goiter may be so rigidly locked in the mediastinum, however, that no movement can occur on swallowing.

The differential diagnosis of intrathoracic goiter includes mediastinal tumors (neurofibroma, dermoid, teratoma, and thymoma), cysts (bronchogenous and enterogenous), aneurysm of the aortic arch and its major divisions, lymph node masses (malignant lymphoma, metastatic cancer, sarcoid), and bronchogenic carcinoma. Enlargement of the thyroid with tracheal displacement is the most striking feature and frequently occurs at a higher level than in the other lesions listed. Laminagraphy may contribute to a diagnosis. Infrequently, angiocardiography may be indicated. A definitive diagnosis has been made in some instances by radioactive iodine uptake studies, although this test is not always positive and certainly not infallible.

SUMMARY AND CONCLUSIONS

1. Five cases of proved posterior mediastinal goiter have been presented, with illustrative roentgenograms of 4 of the cases.

2. The common locations for thyroid gland enlargement have been described, with a discussion of variations in the position of the thyroid mass.

3. The roentgen diagnosis and differential diagnosis of mediastinal goiter are discussed, with special emphasis on the posterior type.

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SUMMARIO IN INTERLINGUA

Struma Postero-Mediastinal

Es reportate cinque casos de struma postero-mediastinal. Tal strumas pote esser situate inter le trachea e le esophago o posterior al esophago. Le apparentia roentgenographic es illo de un homogenee, ben circumscribite massa que es usualmente bilateral sed lateralmente asymmetric. Quando le struma es situate posterior al esophago, il occurre displaciamento anterior e curvation del trachea e del esophago insimul con deviation lateral. Quando le sito es inter le trachea e le esophago, le trachea es displaciate anteriormente e le esophago posteriormente. Conditiones que debe esser differentiate es cystes e tumores mediastinal, aneurysmos del arco aortic e de su brancas, massas de nodo lymphatic, e carcinoma bronchogene.

Telepaque Opacification of Radiolucent Biliary Calculi

The "Rim Sign"[1]

EMANUEL SALZMAN, M.D., and M. ROBERT WARDEN, M.D.

BILIARY CALCULI may be identified as defects in contrast-filled biliary structures, by the density of the calcium content, and by the presence of gas-containing fissures. The purpose of this report is to describe an additional sign, the opacification of radiolucent biliary calculi after repeated doses of Telepaque.

Theander (1) observed a case of unproved cholelithiasis in which this opacification phenomenon was apparently present. After an initial x-ray examination of the abdomen failed to reveal opaque biliary calculi, 3 gm. of Telepaque[2] were given, with failure of the gallbladder to visualize. On repetition of the dose the gallbladder still did not visualize but two small rounded radiolucent calculi in the right upper quadrant were opacified. On intravenous cholangiography these opacified calculi were seen to be within the gallbladder. On repeat intravenous cholangiography one month later the gallbladder was not demonstrable and gallstones were no longer visible. The patient refused cholecystectomy.

Our observation of opacification of biliary calculi was made while exploring the possible advantages of repeated doses of Telepaque in patients whose gallbladders failed to visualize or visualized only faintly after conventional 3-gm. Telepaque examinations. These patients were placed on a three- or four-day regimen of 3 gm. of Telepaque daily, 1 gm. after each meal. A relatively fat-free diet was observed during this period. The x-ray examination was made on the morning of the fourth or fifth day, with the patient fasting. Opacification of stones was observed in 3 of 34 cases examined by this method or a slight modification thereof.

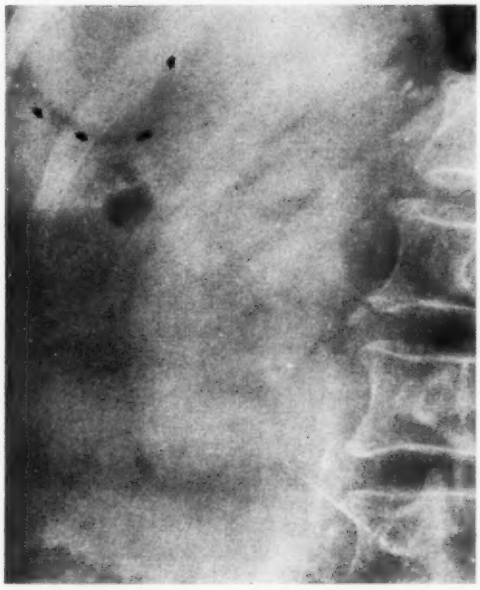

Fig. 1. Case I. After 3 gm. of Telepaque, faint visualization of gallbladder (arrows). No opaque calculi seen.

The circumstances under which the biliary calculi became opacified were similar in our 3 cases and in the case reported by Theander. Initially, no opaque calculi were visible and the gallbladder either did not visualize or visualized only faintly after the conventional dose of Telepaque (Figs. 1, 3, and 5). The stones were opacified only after at least one or, usually, several repeated daily doses of 3 gm. of Telepaque. In Theander's case and in 1 of ours (Case II), the opacification of gallstones occurred in the absence of gallbladder visualization. In 1 of our cases the gallbladder was faintly visualized (Case I), and in 1 well visualized (Case III). Opacification of common duct stones occurred in 2 of our cases (Cases I and III) in the absence of common duct visualization.

[1] From the Division of Radiology, Denver General Hospital, and the University of Colorado Medical Center, Denver, Colo. Accepted for publication in January 1958.

[2] Brand of iopanoic acid, Winthrop Laboratories, New York, N. Y.

Fig. 2. Case I. After 3 gm. of Telepaque each day for three days, faint visualization of gallbladder and opacification of a gallstone (upper group of arrows). Three opacified stones in common duct (lower group of arrows).

Fig. 3. Case II. After 3 gm. of Telepaque, no visualization of the gallbladder. No calculi visible.

The opacification of the biliary stones was characterized by a generalized, rather faint increase in overall density, with a sharp line of increased density outlining their periphery (Figs. 2, 4, and 6). We have termed this opacification phenomenon the "rim sign" of biliary calculi.

In 1 of our cases (Case II), an x-ray examination made sixteen days after discontinuation of Telepaque showed the opacification of the gallstone to have disappeared. In Theander's case (1), the opacification persisted for at least eight days but had disappeared on an x-ray examination made after five weeks. All biliary calculi opacified in our 3 cases were corroborated at surgery, as to size, shape, and number, and no additional stones were found. Although chemical analysis was not done, the gallstones and the bile-duct stones in our 3 cases consisted grossly of mixed pigment and cholesterol.

We can only speculate as to the mechanism of the opacification of radiolucent biliary calculi at this time. It would seem almost certain that opacification of these stones is due to a deposit of Tele-

Fig. 4. Case II. After 3 gm. of Telepaque each day for four days, solitary, 3-cm., oval opacified gallstone (arrows)

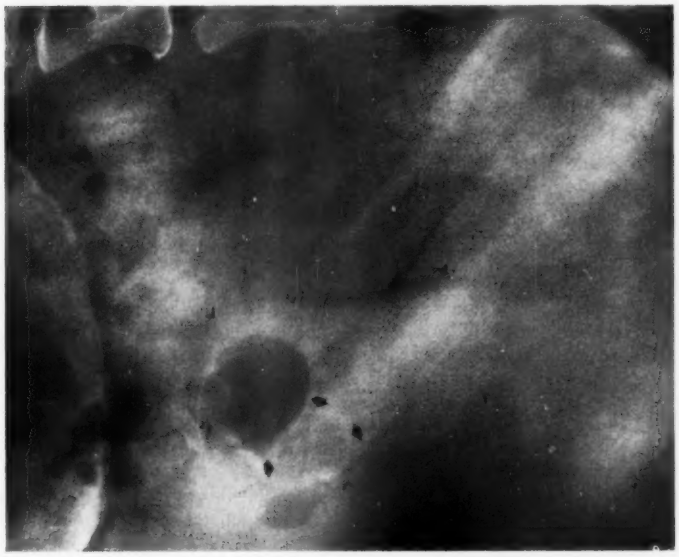

Fig. 5. Case III. Decubitus view. After 3 gm. of Telepaque, fair visualization of large gallbladder with suspicion of 2.5-cm., rounded, radiolucent gallstone (arrows).

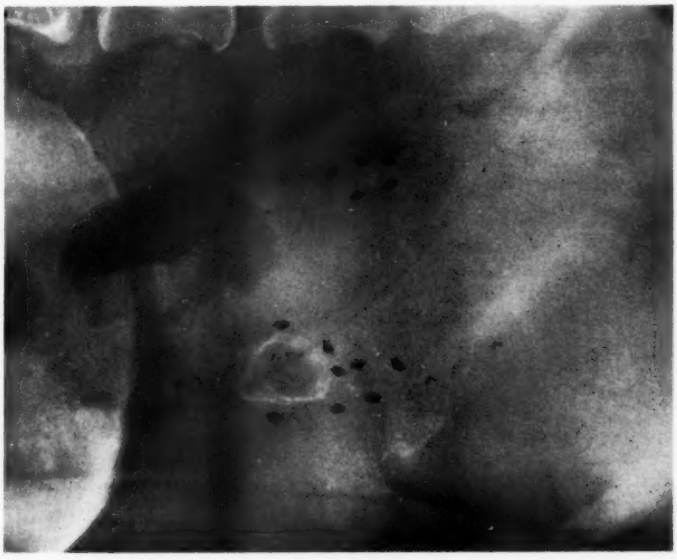

Fig. 6. Case III. Decubitus view. After 3 gm. of Telepaque each day for three days, good visualization of gallbladder and opacification of three gallstones (lower group of arrows); 2 opacified common duct stones (upper group of arrows).

paque or some iodinated product thereof. The appearance of the density after administration of Telepaque and the disappearance after Telepaque was discontinued is substantial evidence in support of this explanation. The pattern of opac-

ification, sharp linear outlining of the stones, and generalized increase in density, favors the idea of surface deposition of Telepaque or an iodinated Telepaque product. Further *in vivo* and *in vitro* studies of this phenomenon are in progress.

CASE REPORTS

CASE I. A 70-year-old white female was admitted to Denver General Hospital on Nov. 6, 1956, complaining of severe abdominal pain for twenty-four hours. An appendectomy had been done in 1948. On examination, there was tenderness in both upper quadrants. Jaundice was not present. A cholecystogram after 3 gm. of Telepaque, Nov. 16, 1956, showed faint visualization of the gallbladder (Fig. 1). A second examination after 3 gm. of Telepaque, on Nov. 19, again showed a faint gallbladder shadow. This finding was again obtained on Nov. 23 following administration of 3 gm. of Telepaque daily for three days. On this examination the gallbladder was seen to contain a round, 1-cm., opacified gallstone and three faceted, 1-cm., opacified stones in the region of the distal common duct (Fig. 2).

On Nov. 26, 1957, a cholecystectomy and common duct exploration were done, revealing a round stone in the gallbaldder, 1 cm. in diameter, and a dilated common duct which contained three 1-cm. multifaceted stones. The pathologic diagnosis was chronic cholecystitis, cholelithiasis, and choledocholithiasis. The gallstones and bile duct stones were not analyzed chemically but appeared grossly to consist of mixed pigment and cholesterol. The postoperative course was complicated by a wound infection and atelectatic pneumonia. The patient was discharged on Jan. 5, 1957.

CASE II. A 77-year-old white female was admitted to Denver General Hospital on April 8, 1957, with jaundice, fever, and abdominal pain of 3 days duration. She had had far advanced chronic rheumatoid arthritis for many years. In 1951, a splenectomy was performed for hypersplenism. On examination, the skin was markedly icteric. The liver was moderately enlarged, and tenderness was elicited in the right upper quadrant. The jaundice gradually subsided, disappearing on May 2, 1957. A cholecystogram after 3 gm. of Telepaque on April 17, 1957, failed to demonstrate the gallbladder. Cholecystography was repeated on May 2 and again the gallbladder failed to visualize (Fig. 3). Three grams of Telepaque was then given daily for four days, and on May 6 a solitary oval stone, 3 cm. in diameter, in the region of the gallbladder, was opacified. The gallbladder was still not demonstrable (Fig. 4). An intravenous cholangiogram on June 6 failed to show any of the biliary structures or the opacified stone previously seen.

On June 6, 1957, right upper quadrant pain recurred, and a cholecystectomy and common duct exploration were done (June 7). The pathological diagnosis was chronic cholecystitis and cholelithiasis. A solitary round, yellow and brown gallstone, 3 cm. in diameter, was found, probably of mixed cholesterol and bile pigment. Chemical analysis was not done. The patient died on June 8, 1957, of congestive heart failure. Autopsy was not performed.

CASE III. A 39-year-old Spanish-American female was admitted to Denver General Hospital on April 15, 1957, complaining of postprandial epigastric discomfort and fatty food intolerance for three years. She had a hysterectomy in 1953 for endometriosis. Examination revealed slight supraumbilical tenderness. A cholecystogram after 3 gm. of Telepaque, Sept. 22, 1954, had failed to visualize the gallbladder. Faint visualization of the gallbladder with 3 gm. of Telepaque was obtained on Feb. 15, 1957, but the presence or absence of calculi could not be determined. On March 7, a large gallbladder was demonstrated, containing a probable solitary rounded radiolucent calculus 2.5 cm. in diameter (Fig. 5). A cholecystogram after 3 gm. of Telepaque on April 5 showed good visualization of a large gallbladder, confirming the presence of a solitary partially opacified radiolucent calculus. Three grams of Telepaque were then given each day for three days and three opacified stones were seen in a well visualized gallbladder and two opacified stones in the region of the common duct (Fig. 6).

Cholecystectomy and choledochotomy were done on April 16, and 2 stones were removed from the common duct; 3 stones were present in the gallbladder. Grossly, the stones were multifaceted, black and yellow, resembling mixed cholesterol and bile pigment stones. The pathologic diagnosis was chronic cholecystitis, cholelithiasis, and choledocholithiasis. The patient was discharged on April 26, 1957, after an uneventful postoperative course.

SUMMARY

Opacification of radiolucent biliary calculi may occur after repeated doses of Telepaque. This consists in a rather generalized faint increase in the shadow of the stone, with a sharp linear density outlining the periphery—the "rim sign."

This opacification phenomenon is probably due to deposition of Telepaque or an iodinated product on the surface of the stones.

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SUMMARIO IN INTERLINGUA

Le Opacification, Per Medio De Telepaque, De Radiolucente Calculos Biliari

Le autores reporta un nove signo pro le demonstration de radiolucente calculos biliari post repetite doses de Telepaque. Illes appella le signo le "signo de margine." Illo esseva demonstrate in 3 casos in que le vesica biliari esseva non visualisate, vaguemente visualisate, e ben visualisate, respectivemente. Initialmente ni le vesica ni le calculos esseva visualisabile post le dose conventional de 3 g de Telepaque. Il esseva solmente post repetite doses del substantia de contrasto—3 g per die durante tres o quatro dies—que le opacification del calculos occurreva. Iste opacification esseva characterisate per un satis vague augmento del umbra general del calculos sed un acute delineation contornal de densitate augmentate. Isto es le "signo de margine." Un simile opacification de calculos del ducto commun occurreva in 2 casos in le absentia de visualisation del ducto commun. In omne iste casos, le presentia del calculos esseva confirmate al operation.

Le phenomeno de opacification es probabilemente le resultato de un deposition de Telepaque o de un iodate producto de illo al superficie del calculos.

Cecal Invagination by a Mucocele of the Appendix[1]

MATTHEW W. ELSON, M.D.

THE DISCOVERY of a sharply defined, polypoid, intraluminal, cecal mass on barium enema study should suggest the possibility of an invaginating mucocele in the differential diagnosis.

CASE REPORT

A 33-year-old white female was admitted to the medical service of the Ohio State University Hospital in October 1954, complaining of easy fatigability. She gave a history of moderate weight loss and irregular bowel habits, for which she frequently took laxatives. There was no history of melena. She denied ever having symptoms of appendicitis.

Examination of the abdomen revealed deep tenderness in the right lower quadrant, and two examiners thought they felt a small mass in that region. The laboratory studies were normal except for a mild anemia—3,780,000 red blood cells; hemoglobin 11.2 gm. Stools were repeatedly negative for occult blood.

Barium enema examination showed a well delineated mass attached to the medial wall of the cecum. This was entirely intraluminal, as demonstrated by barium-air contrast studies (Fig. 1); while slightly movable, it could not be separated from the cecum at its point of attachment. The appendix did not fill with barium. The roentgen diagnosis was lipoma, though carcinoma of the cecum could not be excluded.

At surgery the appendix was found to be distended to approximately 2 cm. in diameter; continuous with it was a mass extending into the cecum. The cecum was opened and found to contain a smooth, tense, yellow tumor protruding from the lumen of the appendix. At the time this was thought to be a carcinoid. The ileocecal valve was sufficiently far from the lesion to permit a wedge resection of the appendix together with the tumor and a fringe of bowel wall.

The gross specimen (Fig. 2) consisted of a short appendix, 3.5 cm. in length and 2.4 cm. in diameter at its base. Lying in what would be the lumen of the cecum was a soft, cystic, thin-walled mass measuring 2.5 cm. in diameter, in direct continuation with the mass in the appendix itself. The final microscopic diagnosis was mucocele of the appendix.

DISCUSSION

The incidence of mucocele has been reported to be 0.1 to 0.5 per cent in surgically removed appendices. The condition was first described in 1842 by Rokitansky, who referred to it as "hydrops of the appendix." Over 500 cases have since been reported, but in very few has a preoperative diagnosis been made.

Fig. 1. Barium-air contrast study of the colon. A. Terminal ileum. B. Invaginated mucocele. C. Cecum.

The condition originates in a gradual stenosis or obstruction of the proximal appendiceal lumen, with an actively secreting mucosa, leading to increasing distention of the appendix (1–3).

Phemister (4) has observed that most cases occur after thirty-five years of age, during the involution of the appendix. This retrogression and obliteration of the lumen, especially near the base, can occur while the distal mucosa is still actively secreting. The normal appendix may secrete 1 to 2 c.c. daily. Once the mucocele

[1] From Ohio State Medical Center, Columbus, Ohio. Accepted for publication in January 1958.

has developed, and the tension within it rises, the thin diaphragm at its base will tend to be pushed into the lumen of the cecum and thus show the first stage of a potential invagination or intussusception.

Symptomatology is not too helpful in the diagnosis. A middle-aged person may complain of vague dyspepsia with a history of one or more attacks of cramping pain in the right lower quadrant and complete relief at intervals. About one-fourth of the patients may have melena (5). The only positive physical finding may be a firm, globular, slightly tender mass in the right lower quadrant.

A plain radiograph of the abdomen may show superficial calcium deposits within the right lower quadrant mass (3, 6–8). On barium enema examination the appendix usually fails to fill, and a round, sharply outlined soft-tissue mass is seen in the cecal region, inseparable from the cecal wall but without connection to the adjacent parenchymatous structures. Much of the credit for describing the radiologic features must be given to Åkerlund (9) and Euphrat (6).

Occasionally the cyst will invaginate the cecal mucosa ahead of it and protrude into the lumen, as in the case presented above. When this occurs, the x-ray picture will reveal barium surrounding the invaginated cystic appendix in the cecum. Differential diagnosis, however, is still difficult. To be considered are ovarian cyst, appendiceal abscess, retroperitoneal tumor, cecal tumor, and occasionally urinary calculi. Contrary to the opinion that mucoceles are not visible by radiologic methods, Vorhaus (2) emphasizes the fact that many such lesions are detectable by means of barium enema examination.

Various authors (5, 10–17) have reported similar cases of partial invagination of mucocele of the appendix into the cecum. Some of the patients (5, 10, 16, 17) had preliminary barium enema examinations, with the preoperative demonstration of an intraluminal cecal mass similar to the one described here.

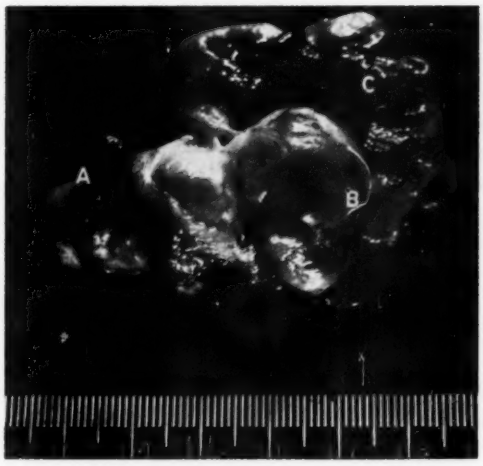

Fig. 2. Pathologic specimen. A. Appendiceal mucocele. B. Invaginated mucocele. C. Cecum.

SUMMARY

A case of invagination of a mucocele of the appendix into the cecal lumen in a woman of thirty-three is reported.

While the exact diagnosis of a mucocele of the appendix is difficult, radiographic demonstration of a sharply defined, polypoid, intraluminal cecal mass with no appendiceal filling should suggest this possibility. Occasionally the mucocele may contain calcium, which is of diagnostic significance.

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SUMMARIO IN INTERLINGUA

Invagination Cecal Per Un Mucocele Del Appendice

Es reportate un caso de invagination del passage cecal per un mucocele del appendice in un femina de trenta-cinque annos de etate.

Durante que le exacte diagnose de un mucocele del appendice es difficile, le constatation de un acutemente definite polypoide massa intraluminal del ceco, sin plenation appendical, deberea suggerer iste possibilitate. A vices le mucocele contine calcium. Iste facto es de signification diagnostic.

The Treatment of Myxomatous Cutaneous Cysts[1]

ROBERT B. ENGLE, M.D.

MYXOMATOUS cutaneous cysts were first described in 1880 by Jones and Markins of St. Thomas' Hospital, London. They were then called synovial lesions of the skin. Definitive articles by Gross (1), and later by Jacox and Freedman (3), outline the pathogenesis, clinical features, and treatment of the disease. Since only 30 cases have been reported to date, further attention to the entity seems warranted.

Only 14 well defined cases could be found in the literature by Gross in 1937. He had himself seen 7 patients (1 with two separate lesions), the last 5 of whom were encountered in a two-month period. Jacox and Freedman added another 7 cases, all seen in three years on an active dermatological service. Isaacson and McCarty (2) brought the total cases to 30 (in 29 patients). To these 4 more are now added.

The age incidence, as given by Gross, ranges from twenty-six to seventy-six years, with an average of forty-eight.

CLINICAL FEATURES

The lesions present, as a rule, as smooth, globular, thin-walled cysts on the dorsal aspects of the fingers, overlying a joint, usually the distal phalangeal. Only once has involvement of a toe been reported (1). The tendency is to a location a little away from the midline. The cysts range in diameter from 4 to 12 mm. and project above the skin for 2 or 3 mm. They are not reducible on pressure. The overlying skin may be normal or have a faint yellow or bluish cast. Since it is in the corium, the cyst moves with the skin. Some of the lesions appear vesicular; others are rough enough to resemble verrucae (2). Occasionally there is central umbilication. If the site is near the root of the matrix, grooving of the nail may result.

Myxomatous cysts may be asymptomatic or slightly painful or tender. Some 75 per cent of the patients are women (1), many of whom seek medical advice because of cosmetic considerations.

The history indicates a duration of a few months to several years. Frequently the patient will have pricked the cyst, with drainage of clear syrupy fluid, invariably followed by recurrence in two to four weeks (1, 2).

PATHOGENESIS

Gross has made a major contribution to knowledge of the progressive development of these cysts through study of lesions excised in varying stages after recurrence. The more or less inevitable recurrence after excision assisted him in this project.

The first change is a degeneration or resorption of the collagen in a localized but poorly limited area of the derma, leaving fibroblasts with but little intercellular material. These cells at first show little or no degeneration, as compared with the collagen. Basophilic mucoid material collects between them and they gradually disintegrate, creating multiple minute cavities, which coalesce to form a gross cyst containing clear glairy fluid of gelatinous or syrupy consistency. This fluid is not secretory but arises from degeneration of local connective tissue. The inner wall of the cyst is irregular at first. Later it becomes smoother and denser. There is no epithelial or endothelial lining. No communication exists with subjacent structures, such as tendons, joints, or bursae. There is no evidence of hemorrhage.

ETIOLOGY

While the cysts arise from a focal degeneration of the corium, the cause for this degeneration is not known. It may be due to local trauma (to the exposed dorsal as-

[1] From the Department of Radiology, St. Luke Hospital, Pasadena, Calif., and the University of Southern California School of Medicine. Accepted for publication in December 1957.

Fig. 1. Case I, before treatment. Note central umbilication, as well as site of recent aspiration.

pects of the fingers) or to small arterial thrombosis.

CASE REPORTS

CASE I: Mrs. E. G., 49-year-old white housewife, was seen with a tender cystic swelling on the dorsal aspect of the distal phalangeal joint of the right index finger. The lesion had appeared about three months earlier and had become larger in the interval. The referring physician, Dr. Jack Segal, had tried aspiration and injection of hydrocortisone without relief. The author is indebted to him not only for referring the patient, but for the diagnosis and the knowledge that radiation therapy was of value.

Examination on May 25, 1955, showed a cystic, umbilicated lesion measuring about 4 × 5 × 2 mm. The overlying skin was tense and waxy (Fig. 1). Roentgen therapy was initiated on this date, with the lesion screened off by lead shields. Treatments of 200 r, measured in air, were delivered on May 25, 27, and 31 (h.v.l. 1.2 mm. Cu). In the absence of visible response and in view of the higher dosage recommended by Jacox and Freedman, 300 and 500 r were delivered on June 3 and June 6, respectively, making a total of 1,400 r in thirteen days.

On June 6 the lesion measured 5 × 5 × 3 mm. and was moderately tense with fluid. Several days later it ruptured. On June 22, it measured 6 × 7 mm., with a central 3-mm. fluid sac. Following this, there was gradual regression. On July 11 all that remained was a 1-mm. central pink area with 5 mm. of ill defined thickening. At a later follow-up, April 9, 1956, there was no evidence of residual disease (Fig. 2).

The following 3 cases were seen by Dr. Stanford B. Rossiter (4) of Menlo Park, Calif., and are included with his kind permission.

CASE II: A 57-year-old woman had a mucoid cyst on the dorsum of the interphalangeal joint of the middle finger of several years duration. An attempt at surgical resection was followed by recurrence. Roentgen treatment was then tried, with a single dose of 1,000 r, measured in air (100 kvp; h.v.l. 3.2 mm. Al; 25 cm. T.S.D.). Erythema and a slight aggravation of symptoms followed, but two weeks later the patient reported that the discomfort had subsided. After three months, however, there was judged to be no significant improvement. Death occurred from other causes within the year, and there was no evidence of regression.

Fig. 2. Case I after roentgen treatment.

CASE III: A 45-year-old man had a mucoid cyst at the distal interphalangeal joint of the index finger. This he frequently injured in his work as an electrician. A single treatment of 1,000 r at 100 kvp, 25 cm. T.S.D., and 3.2 mm. Al h.v.l., failed to produce any regression. A subsequent attempt at surgical excision was followed by recurrence.

CASE IV: A 48-year-old man had a cystic lesion on the dorsum of a distal interphalangeal joint of six years duration. He had had frequent needle aspirations when the cyst became tender or after minimal trauma. Each time the mass recurred, sometimes within two or three days of the aspiration. Following a single treatment of 2,000 r, measured in air, the mucoid cyst almost completely subsided, remaining as a shallow prominence for nearly three months. Subsequently, it increased slightly in size and, when last seen, was about two-thirds its size

when first treated. There had been no recurrence of tenderness or other symptoms, and the patient was well satisfied with the result.

TREATMENT

Myxomatous cutaneous cysts treated by incision and drainage, curettage, cauterization, fulguration, freezing with carbon dioxide snow, and surgical excision invariably recur. One case was cured by incision and drainage followed by electrocoagulation. In another a severe local infection developed following excision, and cure ensued. In general, however, radiation therapy is indicated.

Sutton treated one patient successfully with radium, a total dose of 40 mg. hours. Gross used x-ray therapy in 6 cases, delivering 600 r in two equally divided doses two days apart. The rays were generated at 140 kv and were unfiltered. Five of the patients responded favorably to this treatment. The sixth required a second session totaling 960 r, which reduced the lesion to a third its original volume.

Jacox and Freedman feel that small roentgen doses and protracted delivery invite recurrence. They recommend a single massive dose of 1,400 to 1,600 r, at 100 kv, unfiltered. Several of their earlier patients received doses as high as 450 r repeated weekly for three treatments, yet required additional therapy by the massive dose method.

Isaacson and McCarty, however, gave their patient a total of only 1,000 r in three treatments spaced a month apart (factors not given), and the lesion disappeared.

Analysis of the series reported here reveals that 2 of Dr. Rossiter's patients failed to respond to doses of 1,000 r of superficial x-ray irradiation. The third showed a partial response (satisfactory to the patient) to a single dose of 2,000 r. The author's personal case responded to 1,400 r of more penetrating radiation (h.v.l. 1.2 mm. Cu).

SUMMARY

1. Four cases of myxomatous cutaneous cysts are reported and the literature is reviewed.

2. The cysts almost invariably recur after surgery. Irradiation probably remains the treatment of choice in spite of two failures reported in this series.

3. Further studies of optimal quality and quantity of radiation for these lesions are indicated. Present experience suggests that 1,500 to 2,000 r, depending on the half-value layer selected, may be necessary to achieve their control.

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SUMMARIO IN INTERLINGUA

Le Tractamento De Myxomatose Cystes Cutanee

Myxomatose cystes cutanee es lesiones cystic, lisie, globular, a parietes tenue, que se manifesta usualmente al aspecto dorsal del digitos, al sito de un articulation subjacente. Illos ha lor origine in un degeneration focal del corio, ben que le causa precise de iste degeneration non es cognoscite. Illos pote esser asymptomatic o levemente dolorose o sensibile sub pression. Le ablation chirurgic es sequite quasi invariabilemente per lor prompte recurrentia. Le resultatos effectuate per roentgenotherapia es melior, sed in 2 ex le 4 casos reportate in le presente articulo, irradiation non succedeva, e in un tertie le lesion non esseva eradicate completemente.

Studios additional relative al optimos de qualitate e de quantitate del irradiation in casos de iste lesiones es indicate. Le experientia usque nunc colligite suggere que 1.500 a 2.000 r—secundo que qual spissitate de medie valor es seligite—es probabilemente necessarie pro effectuar lor suppression.

X-Ray Transmission Factor in Estimating Bone Density[1]

GEORGE P. VOSE, M.S.

BONE DENSITY, which is affected by the dietary regimen and certain pathologic situations, has become an extremely important measurement in nutrition and biologic research. Although bone ashing technics have been in common use for a long time, measurements of bone density *in vivo* have been practiced only in recent years. Mack (2, 3), who in 1927 began to use a radiographic photometric method for assessment of the mineral content of bone, has made many valuable contributions in this field. Other investigators have used variations of her technic for measuring the changes in mineral content of bones in man and in experimental animals.

The photometric method of Mack has been developed to a high degree of precision, and quantitative bone density values are derived through the use of a recently described semiautomatic integrating microphotometer (4). However, since large amounts of film are consumed in that method, an alternate system which would not require the exposing and processing of film would be advantageous. With this in view, a device which is capable of rapid measurements of the x-ray transmission factor of bone without the use of film has been constructed in this laboratory and will be described herein. Since x-ray transmission is related in a known manner to the density of bone, the transmission factor obviously becomes useful in detecting changes in skeletal mineralization status.

The device is similar to that used for measuring linear x-ray absorption coefficients of elements. Figure 1 is a generalized diagram illustrating its principle. A very sharp, collimated and filtered beam of x-radiation is made to pass through the bone for which the transmission factor is to be determined. A short metallic tube on the opposite side of the bone conducts the residual primary rays to an x-radiation detector. The ratio of the initial intensity to the transmitted intensity is determined by comparing the detector readings with the bone in place and, again, not in place. The transmission factor is then determined by means of the equation

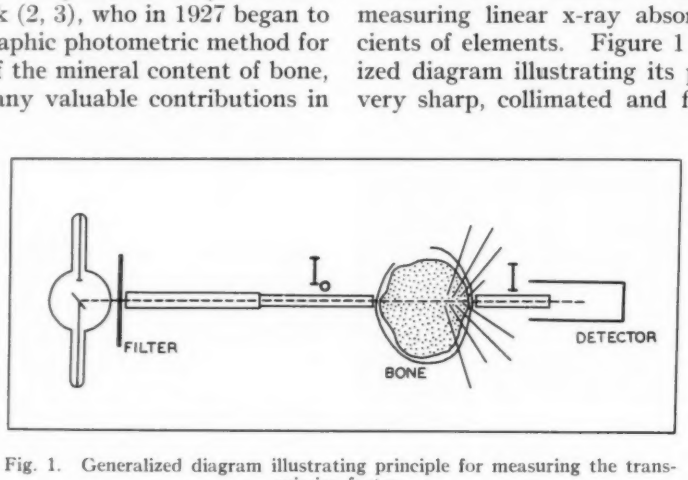

Fig. 1. Generalized diagram illustrating principle for measuring the transmission factor.

$$TF = I/I_0 \qquad (1)$$

where I is the intensity after passing through the bone and I_0 is the initial intensity. The lower the ratio of I to I_0, the denser or thicker the bone.

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[1] From the Nelda Childers Stark Laboratory for Human Nutrition Research, Texas Woman's University, Denton, Texas. Accepted for publication in January 1958.

There are several complicating factors which affect the apparent x-ray absorption by bone. These will be discussed individually in the following section.

THEORETICAL ASPECTS

The x-ray transmission factor I/I_0 is affected by the chemical composition and thickness of the absorber. According to its composition, a material will have a specific linear absorption coefficient which is numerically equal to the fractional reduction of beam intensity per centimeter of absorber. For thin materials this can be symbolically written

$$\mu = I/I_0 \times 1/x \qquad (2)$$

where μ is the linear absorption coefficient, I is the intensity after passage through the absorber, I_0 is the initial intensity, and x is the thickness of the absorber. Since I/I_0 is the ratio of two numbers and x is a thickness, then μ may be expressed in units of absorption per centimeter of thickness of material. X-ray absorption, of course, is not directly related to the thickness of the material. Instead, the intensity of the x-ray beam is reduced by a fractional amount as successive absorptive layers of equal thickness are penetrated. This effect is shown graphically in Figure 2, which illustrates the relationship between the thickness of absorber (in this case bone, having an absorption coefficient of 0.36) and the intensity of the transmitted rays. It can be seen that, in theory, an infinite thickness would be required to reduce the intensity to zero.

Other factors which affect μ are the effective atomic number of the absorbing material and the wave length of x-radiation.

Although the chemical structure of bone is not completely understood, there is good agreement on the atomic composition, that is, the relative quantities of each element. Mack has shown the following approximate formula to be satisfactory for bone ash:

$$n[Ca_3(PO_4)_2]\cdot CaCO_3 \qquad 2 \leq n \leq 3.5$$

Her investigations have shown that for

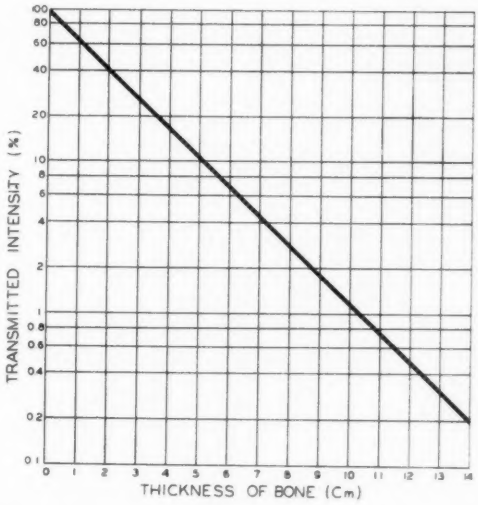

Fig. 2. Graph showing how the intensity of an x-ray beam is reduced by a bone whose linear absorption coefficient is $\mu = 0.36$ cm.$^{-1}$

$n = 2.5$, calcium is responsible for 79.6 per cent of the true absorption, phosphorus for 14.8, oxygen for 5.5, and carbon for approximately 0.1 per cent. The use of a median value of 2.5 leads to an error of less than 0.5 per cent within the expected range variation of n. Since the absorber in the case under discussion consists of bone mineral and organic material within and covering the bone, each of these components accounts for a part of the absorption. Organic material, including ossein and fat, represents about 35 per cent of the total bone by weight. Since the components of soft tissue have smaller effective atomic numbers than the calcium and phosphorus in bone ash, their absorption coefficients are relatively small. However, since the exact chemical nature of bone material and organic matter cannot be accurately measured in living subjects at the present time, this study reports bone values in terms of transmission factor and percentage transmission only.

Wave length is closely associated with the degree of x-ray absorption. Since the absorption by bone and soft tissue varies with changes in wave length, the kilovoltage must be controlled within close limits.

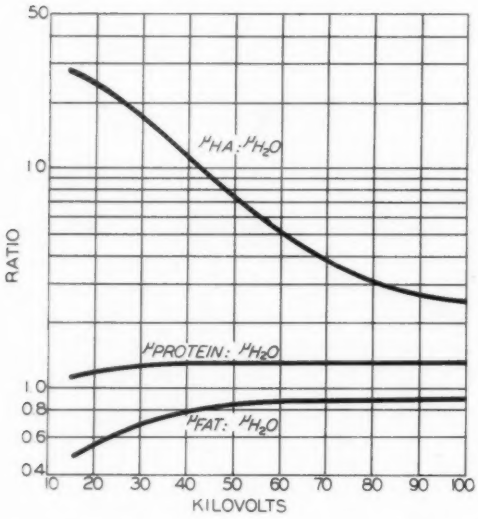

Fig. 3. Ratio between linear absorption coefficients of hydroxyapatite, water, protein, and fat at different monochromatic radiation energies (Omnell).

The ratios between linear absorption coefficients of bone ash (hydroxyapatite), water, protein, and fat at different kilovoltages are shown in Figure 3. Since a panel kilovoltmeter cannot provide a precise energy indication, the device described in this report incorporates a means of determining the effective kilovoltage from one x-ray machine to another within close limits. This is accomplished by measuring the transmission at 10 mas through 6 mm. of aluminum at a fixed distance of 20 inches. The relationship between the transmission and the effective kilovoltage is shown in Figure 4, which provides a means of calibrating the meter with the actual effective kilovoltage. In the process to be described, 68 kvp is required with 0.5 mm. inherent aluminum filtration.

As a practical use of the x-ray transmission factor of bone, let us consider measurements of a particular bone before and after a certain interval of time. If the bone could grow between measurements so that its thickness is increased but with the total amount of absorbing material in the bone remaining the same, its x-ray transmission factor would be unchanged. Actually, what would have occurred is a decrease in the physical density of the bone. Then, if reference could be made to the derived x-ray transmission factor for normal bone of the same thickness, its deviation from this factor would be in proportion to its density. In this hypothetical case, the second density measurement would be below normal.

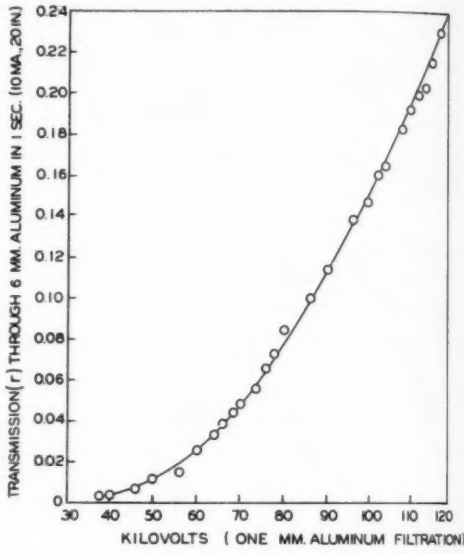

Fig. 4. Relationship of effective kilovoltage and resulting transmission through 6 mm. of aluminum in one second.

EXPERIMENTAL PROCEDURE

The device which has been constructed for the purpose of measuring the x-ray transmission factor of bone is shown in Figure 5. Although it is capable of being attached to the tube housing of any diagnostic x-ray machine with only slight modification, the mobile unit pictured provides versatile head movement which is necessary for accurate bone alignment. A telescoping tube (A), of 3/8-inch inside diameter, projects toward a second nontelescoping tube (B) of the same inside dimensions. The latter tube conducts the residual primary rays to the detector housing (C) and is in a fixed position in relation to the detector. Both tubes are held in alignment by means of an interconnecting framework (D). A 6-mm. aluminum fil-

ter (E) is attached near the detector housing in such a manner that it can be lowered into the x-ray path for a calibrating exposure. The entire assembly can be clamped to the x-ray tube housing by means of a single thumb screw, which engages a circular plate (not shown); a 0.5-mm. aluminum filter is placed between the plate and the tube housing.

A Model 287 Victoreen Minometer has been found satisfactory for measuring the transmitted x-radiation, since its error is small as long as the wave length is kept fairly constant. In use, a charged 0–0.2 roentgen chamber is inserted into the detector housing. After exposure, the chamber is transferred to the Minometer, where the x-ray transmission is read in tenths and hundredths of a roentgen. The anatomical location which has been used in this study is the distal end of the femur. A particular advantage of this location is that it normally has only a thin covering of soft tissue.

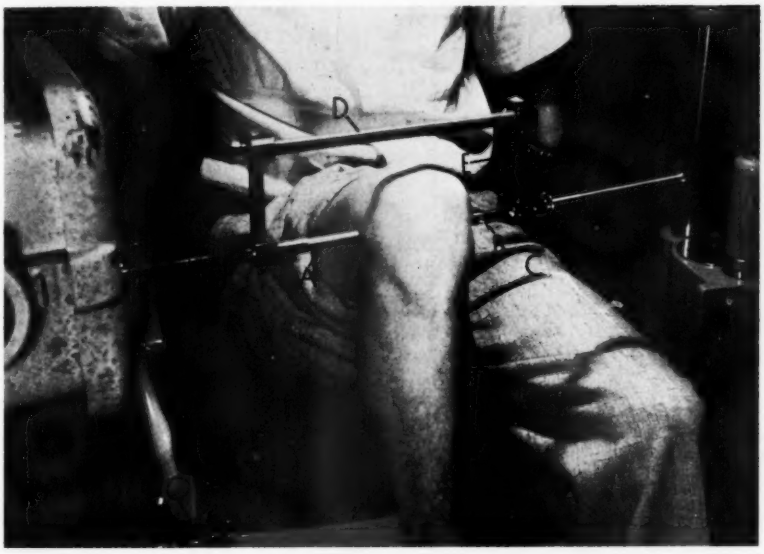

Fig. 5. The transmission measuring device aligned at the distal femur site.

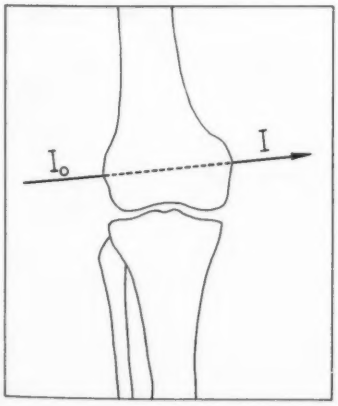

Fig. 6. Path of the x-ray beam through the distal femur.

The procedure for measuring the transmission factor through the beam path shown in Figure 6 is as follows. The condyloid eminences of the femur provide good landmarks for aligning the two tubes of the measuring device. With the leg in the position shown in the photograph, the eminences on each side of the bone are located and a small dot is marked over each with a wax pencil. Then the device is carefully aligned so that the collimated x-ray beam is made to intersect both dots, with the open end of the detector tube placed over the dot on the inside of the leg and the telescoping tube ad-

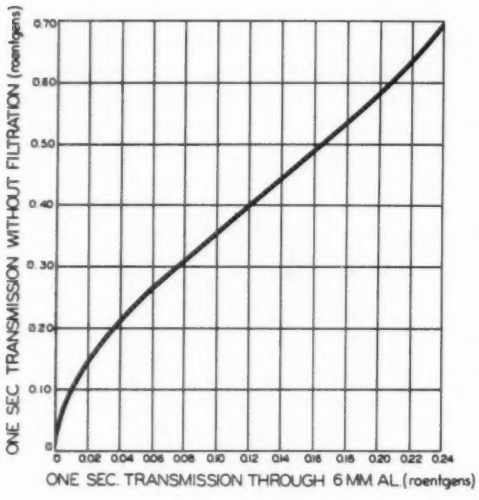

Fig. 7. Relationship of transmission through 6 mm. of aluminum and through air with the same exposure technics.

in Equation 1. Next a calibrating exposure is made to determine the total transmission without the bone in position. Since even the shortest accurate exposure within the limits of this type of hand timer would be sufficient to produce an off-scale reading on the Minometer, the 6-mm. aluminum filter is dropped between the tubes so that it lies across the x-ray path. Then a four-second exposure is made through the filter at the same kvp and ma as before. The resulting reading in roentgens is divided by the exposure time (four seconds) and, after being multiplied by the filter factor (Fig. 7), it becomes I_0 in Equation 1. Next the condyloid thickness in centimeters between the eminences is measured and the deviation in transmission from that of normal bones of the same thickness is computed. This provides a means of classifying the degree of x-ray transmission and relating it to bone density.

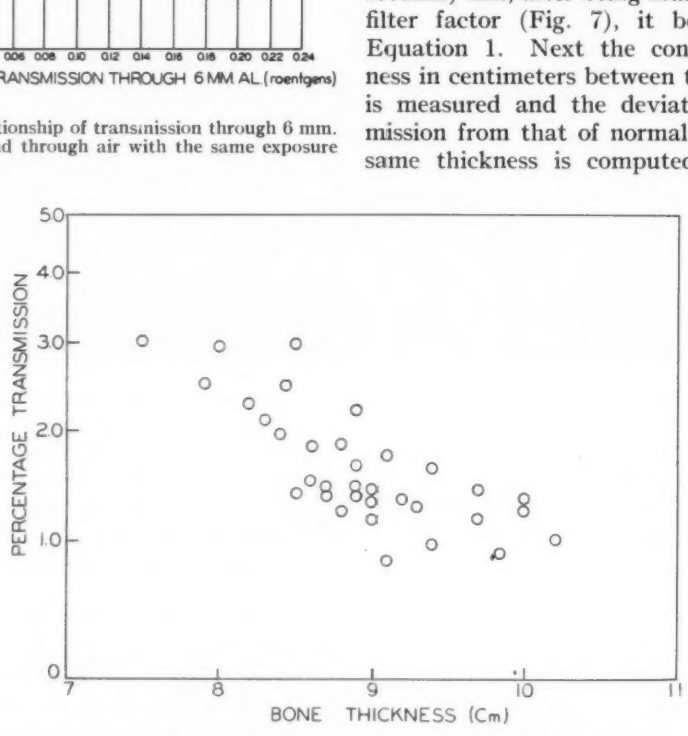

Fig. 8. Scatter diagram representing the relationship between bone thickness and percentage transmission.

justed to cover the outside dot. The charged detector chamber is inserted into its housing and an 8-second exposure at 68 kvp and 10 ma is made. The detector chamber is then transferred to the Minometer, and the reading in fractions of a roentgen is made. This reading, after being divided by the exposure time in seconds, becomes I

The readings obtained from the foregoing two exposures are substituted in the following formula, which provides the transmission factor of the bone.

$$TF = (I/t)/[(I_0/t_0)F] \quad (3)$$

where

I = intensity (r) after passage through bone
I_0 = intensity (r) after passage through 6-mm. aluminum filter
t = time of exposure through bone (seconds)
t_0 = time of exposure through 6-mm. aluminum filter (seconds)
F = filter factor (Fig. 7)

Figure 8 is a scatter diagram representing the relationship between bone thickness and percentage transmission (transmission factor × 100) of the distal femur path. The thicker bones naturally exhibit lower percentage transmissions than do thin bones but, since the points on the diagram do not fall on a line, bone thickness is obviously not the only factor that controls the percentage transmission. It can be assumed, therefore, that density is the variable that causes displacement of the points from the median slope. It would appear that as many as ten classes of bone density (expressed in terms of transmission factor or percentage transmission) could be established after a sufficient number of bones have been examined.

In the case of ten exposures of one bone, the average deviation from the arithmetical mean was 2.0 per cent, with a total range of −1.5 to +3.0 per cent. Hence the instrument error can be considered to be small for this type of measurement. Misalignment of the bone within the path of the x-ray beam might account for fairly large errors. It is evident, however, that with proper care the bone positioning error can be kept quite small so that the method can provide measurements of diagnostic importance.

CONCLUSIONS

1. A method for determining the x-ray transmission factor of bone is described. The transmission factor as determined by this method may be used as a criterion of bone density.

2. The differences in values between individuals are of diagnostic significance.

3. Although the number of anatomical positions for bone density measurements is limited, direct readings of roentgen transmission can promote rapid and inexpensive determinations with a high degree of accuracy.

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SUMMARIO IN INTERLINGUA

Le Uso Del Factor De Roentgenotransmission In Estimar Le Densitate De Osso

Le factor del transmission de radios X in osso pote esser usate como criterio del densitate del osso. Es describite un dispositivo pro determinar le factor de transmission e su application a mesurationes del densitate de osso.

Le transmission in ossos spisse es plus basse que in ossos tenue, sed le spissitate del osso non es le sol factor que determina le procentage del transmission. Per consequente il es a supponer que le densitate representa un variabile importante.

Ben que le numero del sitos anatomic que se presta al mesuration de densitates ossee es restringite, le lectura directe del roentgenotransmission es capace a promover determinationes rapide e incostose con alte grados de exactitude.

Value of the Prone Position for Filling the Obstructed Ureter in the Presence of Hydronephrosis[1]

JACK HANDEL, M.D., and SOLOMON SCHWARTZ, M.D.

HELLMER (2) IN 1946 and Keates (4) in 1954 documented the value of the prone position for demonstrating the obstructed ureter in the presence of a functioning hydronephrotic kidney. The purpose of this brief report is to review and stress the rationale for the use of this position especially in those cases where, for some reason, the examination cannot be made with the patient erect.

The renal pelvis has a muscular coat that normally plays an active role in the ejection of urine into the proximal ureter (1, 3). The pelvis is usually situated at the level of the second lumbar vertebra, on the medial border of the kidney, midway between its anterior and posterior surfaces. In the routine supine position used for urography, the kidney lies in a depression formed by the superior portion of the lumbar lordotic curvature and consequently the proximal ureter transports its contents in an up-hill direction (4) (Fig. 1).

As the hydronephrotic state progresses, the ureteropelvic junction must rotate anteriorly, since expansion is prevented posteriorly by the abdominal wall and medially by the psoas musculature. In the supine position, then, the ureteropelvic junction rotates from the plane of the calyces to a position above them.

Since muscular atrophy results with pelvic dilatation, active ejection of urine is inefficient and urinary propulsion is due primarily to the force of excretion, so long as the patient remains supine (4).

Another factor that may be responsible for poor ureteral visualization with the patient supine is that urine containing a contrast medium has a higher specific gravity than the natural product. The contrast material, therefore, gravitates to a position below the pelvic exit. Early mixing at the superior level is poor, urine of relatively low contrast density enters the ureter, and inadequate ureteral definition is obtained.

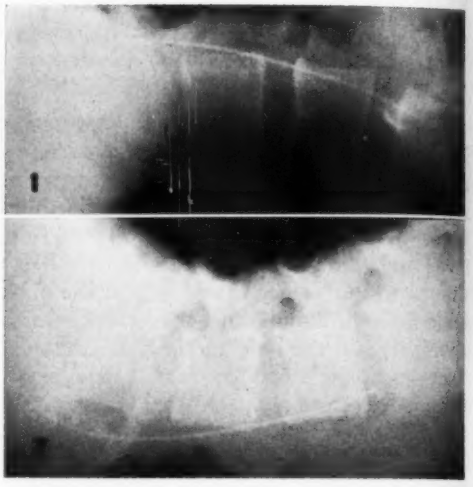

Fig. 1. Patient supine. Transabdominal lateral view with catheter in left ureter. The ureter follows an uphill course.

Fig. 2. Patient prone. Transabdominal lateral film shows ureter taking a downhill course.

With the patient prone, the relationships of the calyces and ureteropelvic junction are reversed; the proximal ureter runs downhill, and the force of gravity makes up for the deficit in motor function (Fig. 2). Use of this position has enabled us to save considerable time in establishing the nature and site of the obstructive mechanism in hydronephrosis (Figs. 3 and 4). Rarely, where pelvic emptying is slow and ureteral filling is poor, this same technic may be employed successfully in patients with no evidence of hydronephrosis. The reason for this is not clear.

SUMMARY

The rationale for the use of the prone position in examination of the obstructed ureter is presented.

[1] From the Department of Radiology, Jewish Hospital of Brooklyn, Brooklyn, N. Y. Accepted for publication in December 1957.

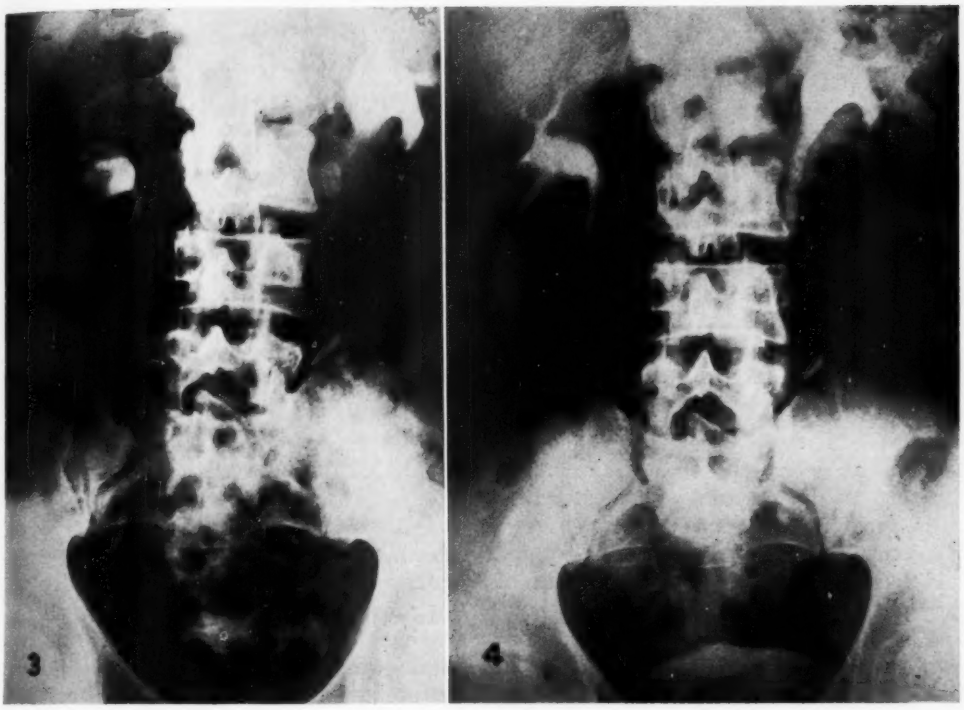

Fig. 3. Fifteen-minute supine film. Pyelectasia without ureteral filling.
Fig. 4. Fifteen-minute prone film made immediately after supine film reproduced in Fig. 3. Ureteral filling is excellent and low obstructive ureteropathy is shown.

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SUMMARIO IN INTERLINGUA

Le Valor Del Decubito Ventral In Replenar Ureteres Obstruite In Casos Con Hydronephrosis

Quando le routinari decubito dorsal es usate in le execution de un examine urographic, le ren se trova in un depression formate per le portion superior del lordotic curvatura lumbar, e le ureter proximal—per consequente—transporta su contento in un direction ascendente. In le presentia de hydronephrosis progressive, le junction ureteropelvic es rotate ex le plano del calyces verso un position supra illos. Quando le pelve es dilatate, il resulta atrophia muscular, le ejection active de urina deveni inefficace, e le propulsion urinari es effectuate primarimente per le fortia del excretion. In plus, le substantia de contrasto tende a gravitar verso un position infra le exito pelvic, de maniera que un inadequate definition ureteral es obtenite.

Quando le patiente se trova in decubito ventral, le relationes es revertite. Le ureter proximal seque un curso descendente, e le fortia del gravitate compensa le deficit del function motori. Iste position resulta in un economia considerabile de tempore in establir le natura del mechanismo obstructive in casos de hydronephrosis.

A New Intensifying Screen-Film Combination for Angiocardiography and Other Roentgenographic Procedures[1]

GOFFREDO G. GENSINI, M.D.[2]

RECENT REPORTS (1, 2, 3) have focused the attention of the medical profession and of the general public on the hazards of diagnostic roentgenology. At the same time, radiologists have felt the need for shorter and shorter exposures in many situations, particularly in angiocardiographic technics (4). The ideal solution of this problem would be a reduction in exposure time with a decrease in radiation exposure to the patient, without sacrifice of the diagnostic quality of the image.

Recent progress in the photographic field has resulted in the development of extremely fast panchromatic emulsions. The ASA speed of these films, when properly handled, is from 320 to 2,000 per cent higher than that attainable with the usual emulsions. In view of the fact that the formation of the image on x-ray film is mainly due to the visible light fluorescence of the intensifying screen (98–99 per cent), it appeared that progress made in the photographic field should be exploited in roentgenography with intensifying screens. Such a screen should fluoresce in the region of the spectrum to which the emulsion is most sensitive (5). When intensifying screens were first introduced in 1886, the emulsions available were of the so-called "ordinary" or color-blind type. Their peak sensitivity was at about 4,300 Å. The intensifying screens, therefore, were fabricated to have their peak emission at the same wave length.

Today, as we have indicated, the fastest films are panchromatic. Thus, it seemed logical to employ a different type of screen, the peak emission of which would match the peak spectral sensitivity of the most sensitive contemporary photographic emulsions. Ordinary fluoroscopic screens appeared to be suitable for preliminary investigation of this hypothesis, not only because of the wave length of their light emission, but also because they are more efficient than conventional intensifying screens (6).

TABLE I: DENSITY ABOVE BASE AND FOG OF LAST STEP OF THE PENETROMETER (NO. 11) IN NINE SCREEN-FILM COMBINATIONS (CONSTANT EXPOSURE FACTORS: 72" DISTANCE; 300 MA; 1/30 SEC.; 68 KVP; 1.5 MM. AL EQUIVALENT FILTRATION)

Screens	Films		
	Blue Brand	Royal Blue	Royal X Pan
Par speed	0.07	0.10	0.10
Lightning special	0.13	0.29	0.14
CB2	0.00	0.03	1.15
Development, min.	5	5	10

Three films and three screens were selected for the present investigation. Two of the films were x-ray films: Kodak Blue Brand and Kodak Royal Blue. The third was the single emulsion Panchromatic Kodak Royal X. They were developed in "Kodak Liquid X-ray" at 68° F. The screens selected were DuPont-Patterson Par Speed, Lightning Special, and CB2. The apparatus used was a Westinghouse Fluoradex 300.[3] Accuracy of the thermionic timing device was checked with a constant-speed stroboscopic wheel and an Electromec 21-inch Oscilloscope, Model 2135A. A G.E. Penetrometer, Model E-8038A, was used, and the densities of the

[1] Accepted for publication in January 1958.

[2] Chief, Cardiopulmonary Physiology, Department of Researeh and Laboratories, National Jewish Hospital at Denver, Denver, Colo.

[3] The technical assistance of Mr. Otto Aichinger, Supervisor of Denver Area, Denver X-ray Division of Westinghouse, is gratefully acknowledged.

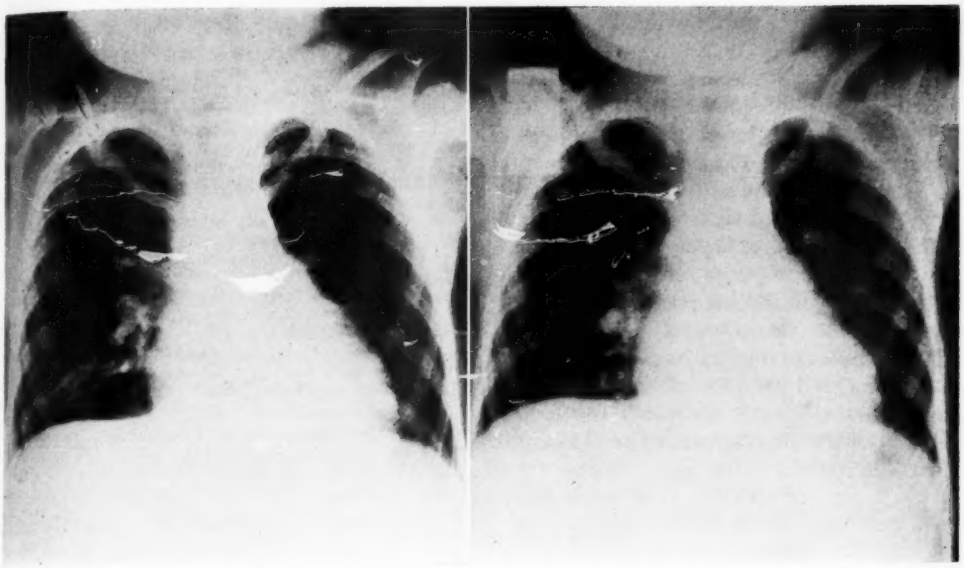

Fig. 1. Chest roentgenograms. That on the left was taken with Par Speed-Blue Brand and conventional technic (milliroentgens at 1 m. = 27). That on the right was taken with CB2-Royal X Pan (milliroentgens at 1 m. = 1.8); a wire mesh has been placed in the upper left corner.

exposed films were determined with a Kodak RT Color Densitometer. All screen-film combinations were studied. The results are summarized in Table I.

The significantly greater sensitivity of the CB2-Royal X combination is evident; in addition, its latitude and contrast range proved to be by far the widest obtained with any of the screen-film pairs used.

The milliampere-seconds (mas) value was then decreased, other variables remaining constant, in order to reach the minimum radiation exposure which would still yield satisfactory densities at a given kilovoltage and distance. At 68 kvp and 72 inches distance, it was found that 0.86 mas (100 ma and 1/120 of a second) yielded a slightly overexposed gray scale on the Royal X/CB2 and extremely underexposed films for the other combinations. Finally, by increasing the kilovoltage to 110, a satisfactory chest film was obtained with 50 microampere-seconds at 72 inches. Reduction of radiation exposure to the patient, as actually measured with a Kelley-Koett ionization chamber, varied from 15- to 50-fold, depending upon the type of conventional technic used (Fig. 1).

The only screens available to us for this study were the fluoroscopic DuPont-Patterson CB2 screens. It can be anticipated that, with more appropriate screens results may be improved still further.[4] It is realized that the size of the phosphor crystals in such screens is somewhat too large for the most desirable resolving power (approximately one-half that of the conventional Par Speed intensifying screens); and reduction in crystal size may decrease the intensity of light emitted. On the other hand, the presence of "quencher" in fluorescent screens tends to diminish the total quantity of visible light emitted; and decrease in concentration of the trace of quencher, permitting some phosphorescence, may be anticipated to increase the amount of light output and thus to enhance the exposure of the film. Omission of the quencher or reduction in its concentration is permissible with the very

[4] E. I. DuPont de Nemours & Co. (Inc.), Products of the Photo Products Department, page 4 (1957).

short exposure times which are made possible by the use of the above described technics. In addition, the Kodak Royal X Pan emulsion can be coated on both sides of the film base, thereby doubling the density obtained at any given exposure.

In summary, the results of this study indicate that a very significant decrease in both the time of exposure and the quantity of radiation employed in roentgenography—medical, industrial, or experimental—can result from the use of phosphorescent intensifying screens specially designed to provide light emission at the wave length to which the fastest contemporary photographic emulsions are most sensitive.

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SUMMARIO IN INTERLINGUA

Un Nove Combination De Lamina Intensificatori E Pellicula, Pro Le Uso In Angiocardiographia E Altere Manovras Roentgenographic

Un studio de varie pelliculas e de varie laminas intensificatori in un varietate de combinationes indica que un reduction significative del tempore de exposition e del quantitate de radiation requirite in le roentgenographia medical, industrial, o experimental pote esser effectuate per le uso de phosphorescente laminas intensificatori de un typo specialmente fabricate pro provider un emission de lumine al longor de undas a que le plus rapide emulsiones photographic de nostre tempore es le plus sensibile.

Le exposition del patiente, practicamente mesurate per medio de un camera de ionisation, se monstrava reducite per un factor de inter 15 e 50 secundo que qual typo de technica conventional es empleate.

EDITORIAL

Reactions from Intravenous Organic Iodide Compounds

Just thirty-four years ago Graham and Cole (1) opened a new field in radiology with their introduction of the concept of selective accumulation of radiopaque material introduced into the blood stream, for roentgen diagnostic purposes. Their studies of the gallbladder were followed by much experimental work with a view to obtaining a similar result in the kidneys. In 1930, Binz and Räth (2) described the first material—"Uroselectan"—which concentrated sufficiently in the collecting system of the kidneys to be of clinical value. The ease of administration, reduction of patient discomfort, plus both the morphological and functional information to be obtained from the intravenous administration of these opaque solutions, opened an entirely new era in the roentgen diagnosis of renal disease. Much more information was now possible, as to both the structure and function of each kidney. Patients would more willingly submit to this procedure than to retrograde injection at an earlier stage of their symptoms, so that cancer and other malignant conditions of the kidneys could be diagnosed while still curable. This has led directly to such recent developments as successful kidney transplants in patients otherwise doomed.

Unfortunately, it was early found that the administration of these iodinated organic compounds is not without danger. The reactions, while not numerous, have always been dramatic. Purification, better packaging, and newer less toxic compounds have brought these unfortunate results to what may be an irreducible minimum, but it seems that as long as blood stream injection is required there will be some reactions of greater or lesser degree.

Some of the fatal reactions must be attributed to coincidental coronary or cerebral vessel occlusion, for all of the catalytic agents necessary for these are present, *e.g.*, strange surroundings, pain, fear, worry, stress, and usually age. Other fatalities may be ascribed to allergic or sensitivity reactions to the compounds employed. These seem to be completely unpredictable, even with the various suggested methods of pretesting.

Iodism or iodine poisoning does not seem to be a factor in these deaths, since little if any free iodine is liberated from the organic compounds. Also this is a more chronic condition, resulting from repeated small doses over long periods, as with inorganic iodide compounds.

The Symposium on Reactions to Intravenous Organic Iodide Compounds appearing in this issue of Radiology (pp. 1-27) is an attempt to review our knowledge of these dramatic but infrequent reactions and find, if possible, some way of either avoiding or reducing their occurrence below the "irreducible minimum." Radiologists must realize that, as long as they introduce large doses of contrast material into the blood stream, an occasional patient will react adversely. Actually, as compared with most drug doses, the amounts employed must be considered quite safe. The reactions that do occur, however, should make us realize that organic iodide compounds should not be administered intravenously without a good indication.

EVERETT L. PIRKEY, M.D.

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NATIONAL COMMITTEE ON RADIATION PROTECTION AND MEASUREMENTS[1]

The increased uses of radiation in both medicine and industry have resulted in a sharp increase in interest in the work of the National Committee on Radiation Protection and Measurements (NCRP). This committee was activated in 1928 with the concurrence of the various radiological societies in an effort to consolidate our national recommendations for presentation on an international basis. The Committee has been in effective operation since then, ever growing and enlarging its terms of reference as the need arose; at present its recommendations are widely recognized and used in the medical, industrial, military, and related applications of radiation, and have become the principal legal support for the enforcement of radiation protection practices in the United States. Many of the recommendations have also been adopted in principle or *in toto* by the corresponding international groups dealing with radiation protection and measurements.

Sponsorship of the Committee encompasses many interests in the field, including the major radiological societies, the American medical and dental associations, industrial and labor groups, and government agencies interested in atomic energy, public health, and military aspects. The Committee is operated by the National Bureau of Standards as a public service, and its recommendations, prepared as National Bureau of Standards *Handbooks*, are published and sold by the Superintendent of Documents, Government Printing Office, Washington, D. C. The list of the Committee's recommendations given herewith indicates the wide range of interests covered by its eighteen working groups.

This introduction to the NCRP is primarily for the benefit of those who are not familiar with the current work of the group. However, a great number of its current activities are of immediate interest to those concerned with radiation protection and measurements as evidenced by the number of requests for information on forthcoming recommenda-

RECOMMENDATIONS OF THE
NATIONAL COMMITTEE ON RADIATION PROTECTION AND MEASUREMENTS

NBS Handbook No.	Title	Date Issued	Price
42	Safe Handling of Radioactive Isotopes	September 1949	$ .20
48	Control and Removal of Radioactive Contamination in Laboratories	December 1951	.15
49	Recommendations for Waste Disposal of Phosphorus-32 and Iodine-131 for Medical Users	November 1951	.15
51	Radiological Monitoring Methods and Instruments	April 1952	.20
52	Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water	March 1953	.25
53	Recommendations for the Disposal of Carbon-14 Wastes	October 1953	.15
54	Protection Against Radiations From Radium, Cobalt-60, and Cesium-137	September 1954	.25
55	Protection Against Betatron-Synchrotron Radiations Up to 100 Million Electron Volts	February 1954	.25
56	Safe Handling of Cadavers Containing Radioactive Isotopes	October 1953	.15
58	Radioactive-Waste Disposal in the Ocean	August 1954	.20
59	Permissible Dose From External Sources of Ionizing Radiation	September 1954	.30
60	X-ray Protection	December 1955	.20
61	Regulation of Radiation Exposure by Legislative Means	December 1955	.25
63	Protection Against Neutron Radiation up to 30 Million Electron Volts	November 1957	.40

For related handbooks, see also:

No.	Title	Date Issued	Price
57	Photographic Dosimetry of X- and Gamma Rays	August 1954	$ .15
62	Report of the International Commission on Radiological Units and Measurements (ICRU)	April 1957	.40
64	Design of Free-Air Ionization Chambers	December 1957	.20
66	Safe Design and Use of Industrial Beta-Ray Sources	May 1958	.20

[1] This is the first of a continuing series of announcements of the work and programs of the NCRP that will appear in RADIOLOGY.

tions, and an effort will therefore be made to describe these activities in more detail than has been available in the past.

NOTE: Addenda to H 59 and 60 embodying the revised[2] (1957) maximum permissible dose levels have been issued and are available on request from the National Bureau of Standards, Publications Section, Washington, D. C. An addendum to H 54 is in the process of publication.

Revisions of Handbooks 42, 52, 54, 56, 60, and 61 are in preparation; the revision of H 56 (H 65) is expected to become available within the next few months. Announcements will be made as these and new publications are completed.

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[2] Maximum Permissible Radiation Exposures to Man. A Preliminary Statement of the NCRP. NBS Tech. News Bull. **41** (No. 2): 17, 1957; Radiology **68:** 260, 1957. See also revised statement, April 15, 1958 to appear in Radiology, August 1958.

ANNOUNCEMENTS AND BOOK REVIEWS

SIXTH INTERAMERICAN CONGRESS OF RADIOLOGY

As announced in the May issue of RADIOLOGY, the Sixth Inter-American Congress of Radiology will be held Nov. 2-8, 1958, in Lima, Peru. Dr. Vicente Ubillús, General Secretary, wishes to call the attention of radiologists in this country to the fact that, if they have sent in their applications and failed to receive official acknowledgment of their membership in the Congress, this can be claimed at the office of the Congress in Lima. The address is Instituto de Radiologia, "Cayetano Heredia," Hospital Arzobispo Loayza, Lima, Peru.

ARKANSAS RADIOLOGICAL SOCIETY

At a recent meeting of the Arkansas Radiological Society the following officers were elected for the ensuing year: President, W. E. Gray, M.D., Hot Springs; Vice-President, B. A. Rhinehart, M.D., Little Rock; Secretary-Treasurer, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith.

BALTIMORE CITY MEDICAL SOCIETY RADIOLOGICAL SECTION

At a recent meeting of the Radiological Section of the Baltimore City Medical Society, Nathan B. Hyman, M.D., was elected Chairman and James K. V. Willson, M.D., 1100 N. Charles St., Baltimore 1, Secretary-Treasurer.

CALIFORNIA MEDICAL ASSOCIATION RADIOLOGY SECTION

The newly elected officers of the Radiology Section of the California Medical Association are: Chairman, Nathan M. Spishakoff, M.D., Beverly Hills; Secretary, William H. Graham, M.D., 630 East Santa Clara St., San Jose; Assistant Secretary, Frank C. Binkley, M.D., 635 East Union St., Pasadena.

FLORIDA RADIOLOGICAL SOCIETY

At the Twenty-sixth Annual Meeting of the Florida Radiological Society, the following officers were elected for the year 1958–1959: President, C. Robert DeArmas, M.D., Daytona Beach; Vice-President, John P. Ferrell, M.D., St. Petersburg; Secretary-Treasurer, Russell D. D. Hoover, M.D., 1717 N. Flagler Drive, West Palm Beach; Councilor to the American College of Radiology, J. Maxey Dell, Jr., M.D., Gainesville; Alternate Councilor to the College, Oliver P. Winslow, Jr., M.D., Coral Gables.

INDIANA ROENTGEN SOCIETY

Newly elected officers of the Indiana Roentgen Society are: President, Wallace Buchanan, M.D., South Bend; President-Elect, John R. Lionberger, M.D., South Bend; Secretary-Treasurer, Chester A. Stayton, Jr., M.D., 313 Hume Mansur Bldg., Indianapolis 4.

RADIOLOGICAL SOCIETY OF LOUISIANA

The Radiological Society of Louisiana at a recent meeting elected officers for the ensuing year as follows: President, J. T. Brierre, M.D., New Orleans; Vice-President, Jerome J. Romagosa, M.D., Lafayette; Secretary-Treasurer, Seymour Ochsner, M.D., Ochsner Clinic, New Orleans 15.

MILWAUKEE ROENTGEN RAY SOCIETY

Newly elected officers of the Milwaukee Roentgen Ray Society are: Morris Moel, M.D., President; Robert W. Byrne, M.D., Vice-President; Joseph F. Wepfer, M.D., 5000 W. Chambers St., Milwaukee 10, Secretary-Treasurer.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the recent annual meeting of the New England Roentgen Ray Society, the following officers were elected: President, Felix G. Fleischner, M.D., Boston; President-Elect, Stanley M. Wyman, M.D., Belmont, Mass.; Vice-President, James R. Lingley, M.D., Framingham, Mass.; Treasurer, Lloyd E. Hawes, M.D., Jamaica Plain, Mass.; Secretary, John E. Gary, M.D., 1180 Beacon St., Brookline 46, Mass.; member of the Executive Committee, H. Peter Mueller, M.D., Belmont, Mass.; Councilor to the American College of Radiology, Magnus I. Smedal, M.D., Boston; Delegate to the Eastern Radiological Conference, George Levene, M.D., Boston.

The guests of honor were Dr. George W. Holmes, Dr. Patrick F. Butler, of Boston, who delivered the Annual Holmes Lecture—"The Radiologist in Court"—and Dr. Frederick W. O'Brien, the three surviving charter members of the organization.

OKLAHOMA STATE RADIOLOGICAL SOCIETY

The Oklahoma State Radiological Society at a recent meeting in Oklahoma City elected the following new officers for the year 1958–1959: President, Sol Wilner, M.D., Tulsa; Vice-President, C. Gene Coin, M.D., Oklahoma City; Secretary, Edmond H. Kalmon, Jr., M.D., 300 Northwest Twelfth St., Oklahoma City; Treasurer, Leland F. Shryock, M.D., Enid.

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY

Newly elected officers of the Pacific Northwest Radiological Society are as follows: President, John H. Walker, M.D., Seattle, Wash.; President Elect, John S. Madill, M.D., Victoria, B. C.; First Vice-President, Norman Bline, M.D., Portland, Ore.; Second Vice-President, Wayne A. Chesledon, M.D., Seattle, Wash.; Secretary-Treasurer, J. Arch Colbrunn, M.D., 1919 Royal Oak Drive, Roseburg, Ore.; member of Executive Committee William Y. Burton, M.D., Portland, Ore.

PENNSYLVANIA RADIOLOGICAL SOCIETY

At its recent annual meeting the Pennsylvania Radiological Society elected the following officers: President, John H. Harris, M.D., Harrisburg; President-Elect, Paul C. Swenson, M.D., Philadelphia; First Vice-President, Lester M. J. Freedman, M.D., Pittsburgh; Second Vice-President, Richard R. Hoffman, M.D., Lebanon; Secretary-Treasurer, Walter P. Bitner, M.D., 234 State St., Harrisburg; Editor, Carl B. Lechner, M.D., Erie; Councilor to the American College of Radiology, D. Alan Sampson, M.D., Ardmore; Alternate Councilor to the American College of Radiology, Newton Hornick, M.D., Pittsburgh.

The next annual meeting will be held in Harrisburg, April 24–25, 1959.

PHILADELPHIA ROENTGEN RAY SOCIETY

The Philadelphia Roentgen Ray Society recently elected the following officers for the year 1958–1959: President, Herman W. Ostrum, M.D.; Vice-President, John T. Brackin, Jr., M.D.; Secretary, Roderick L. Tondreau, M.D., Hospital of the University of Pennsylvania, Philadelphia 4; Treasurer, Randal A. Boyer, M.D.; Counselor-at-Large, Harold J. Isard, M.D.

TENNESSEE RADIOLOGICAL SOCIETY

Recently elected officers of the Tennessee Radiological Society are as follows: President, David Carroll, M.D., Memphis; President-Elect, Granville Hudson, M.D., Nashville; Vice-President, George Henshall, M.D., Chattanooga; Secretary-Treasurer, James J. Range, M.D., P. O. Box 324, Johnson City; Members of the Executive Committee, Ben R. Mayes, M.D., of Nashville, and Horace Gray, M.D., of Memphis. Councilors nominated for the American College of Radiology are Walter Hankins, M.D., Johnson City, and Alternate, J. Marsh Frère, M.D., Chattanooga.

The meeting of the Society was held at the time of the annual Tennessee State Medical Society meeting in Gatlinburg, Tenn. Mr. William Stronach, the speaker of the occasion, gave an address on social trends affecting the practice of radiology.

WASHINGTON STATE RADIOLOGICAL SOCIETY

At a recent meeting of the Washington State Radiological Society, the following were elected to serve the Society in the ensuing year: President, Richard C. Kiltz, M.D., Everett; Vice-President, Lloyd H. Smith, M.D., Wenatchee; Secretary-Treasurer, Wayne A. Chesledon, M.D., 306 Stimson Bldg., Seattle 1, Wash.

INTERNATIONAL CONGRESS OF RADIATION RESEARCH

The First International Congress of Radiation Research will be held at the University of Vermont, Burlington, Vt., Aug. 10-16, 1958, under the joint sponsorship of the National Academy of Sciences-National Research Council and the Radiation Research Society, in co-operation with the European Committee on Radiobiology. Further information can be obtained from Mr. Howard J. Lewis, 2101 Constitution Ave, N. W., Washington 25, D. C.

RADIOACTIVE ISOTOPES COURSE COOK COUNTY HOSPITAL, CHICAGO

A course in the clinical use of radioactive isotopes will be given by I. F. Hummon, M. D., Robert S. Landauer, Ph.D., and associates, at the Cook County Hospital, Sept. 20 through Oct. 10, 1958.

This is a full-time course including lectures, demonstrations, laboratory periods, and clinics. Lecture subjects will include Radiation Physics, Radiation Hazards and Protection, Natural and Artificial Radioactivity, Theory of Measurement, and Counters and Statistics. Clinical studies will cover the preparation, administration, and uptake of tracer materials, thyroid physiology, thyroid neoplasms, blood dyscrasias, blood volume determinations, and other uses of iodine 131, phosphorus 32, and gold 198. Atomic Energy Commission requirements and the obtaining of radioactive isotopes will be discussed.

The course will be offered for a minimum of eight and a maximum of fifteen students. The fee is $200. Inquiries may be addressed to the Registrar, Cook County Graduate School of Medicine, 707 S. Wood St., Chicago 12, Ill.

RADIOLOGY IN WORLD WAR II

The radiology performed in World War II by physicians serving in the U. S. Army Medical Corps is to be the subject of a special volume, under the editorship of Dr. Kenneth D. A. Allen. Dr. Allen is particularly anxious to obtain photographs, diaries, journals, and letters of clinical interest that might be used in this volume. The greatest of care will be taken of such material and full credit will be given to those supplying it.

The book, which is being prepared under the supervision of an editorial staff of radiologists, will appear as a United States Surgeon General's Office publication, through the Historical Unit.

Your co-operation with Dr. Allen and his editorial associates is urged: Address: Kenneth D. A. Allen, M.D., 452 Metropolitan Bldg., Denver 2, Colo.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

BONE AND RADIOSTRONTIUM. By ARNE ENGSTRÖM, ROLF BJÖRNERSTEDT, CARL-JOHAN CLEMEDSON, AND ARNE NELSON. A volume of 140 pages, with numerous figures and tables. Published by John Wiley & Sons, Inc., New York 16, N. Y., 1957. Price $8.75. Printed in Sweden by Almqvist & Wiksells Boktryckeri Aktiebolag, Uppsala, Sweden.

ANOMALIES OF INTESTINAL ROTATION AND FIXATION (INCLUDING MESENTERICOPARIETAL HERNIAS). By ROBERTO L. ESTRADA, B.Sc., M.D., C.M., D. Surg. (McGill), F.R.C.S. (C), F.A.C.S., Demonstrator in Surgery, McGill University, Montreal, Canada; Assistant Surgeon, The Montreal General Hospital; Assistant Surgeon, Reddy Memorial Hospital, Westmount, Canada. A volume of 162 pages, with 75 roentgenograms, 16 drawings, and 1 table. Published by Charles C Thomas, Springfield, Ill., 1958. Price $6.50.

ADVANCES IN CANCER RESEARCH. VOLUME V. Edited by JESSE P. GREENSTEIN, National Cancer Institute, National Institutes of Health, U. S. Public Health Service, Bethesda, Maryland, and ALEXANDER HADDOW, Chester Beatty Research Institute, Institute of Cancer Research, Royal Cancer Hospital, London, England. A volume of 464 pages, with figures and drawings. Published by Academic Press, Inc., New York 3, N. Y., 1958. Price $10.80.

ANGIONEPHROGRAPHY AND SUPRARENAL ANGIOGRAPHY: A ROENTGENOLOGICAL STUDY OF THE NORMAL KIDNEY, EXPANSIVE RENAL AND SUPRARENAL LESIONS AND RENAL ANEURYSMS. By GUNNAR EDSMAN. From the Roentgen Diagnostic Department I of Sahlgrenska Sjukhuset, Gothenburg, Sweden. From the Swedish by Lois Goldie-Kjellman. Supplement 155 to Acta radiologica. A monograph of 142 pages, with 67 figures and 18 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price, paper-bound, Sw. Kr. 30:—.

THE HISTOLOGICAL DISTRIBUTION OF PROTEINASE AND PEPTIDASE ACTIVITY IN SOLID TUMOR TRANSPLANTS: A HISTOCHEMICAL STUDY ON THE ENZYMIC CHARACTERISTICS OF THE DIFFERENT TUMOR CELL TYPES. By B. SYLVÉN AND H. MALMGREN. From the Karolinska Institutet, Cancer Research Division of Radiumhemmet, Stockholm. Supplement 154 to Acta radiologica. A monograph of 124 pages, with 19 figures and 7 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price, paper-bound, Sw. Kr. 30:—.

PRIMARY TUMORS OF THE PELVIC BONES: A ROENTGEN DIAGNOSTIC STUDY OF EIGHTY-THREE CASES. By CARL GUSTAV HELANDER AND ÅKE LINDBOM. From the Roentgendiagnostic Department, Karolinska Sjukhuset, Stockholm, Sweden. Supplement 152 to Acta radiologica. A monograph of 62 pages, with 48 figures. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price, paper-bound, Sw. Kr. 25:—.

RADIOLOGIC EXAMINATION OF THE BRAIN AND SPINAL CORD. By ERIK LINDGREN. From the Roentgen Department, Serafimerlasarettet, Stockholm, Sweden. Supplement 151 to Acta radiologica. A monograph of 148 pages, with 178 figures and 2 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price, paper-bound, Sw. Kr. 35:—.

ROENTGEN MANIFESTATIONS OF ADULT RHEUMATOID ARTHRITIS WITH SPECIAL REGARD TO THE EARLY CHANGES. By PEKKA SOILA. From the Hospital of the Rheumatism Foundation, Heinola, Finland. Translated by Alan R. Beesley, B.A. (Ox.). Acta rheumatologica scandinavica supplementum 1, 1958. A monograph of 144 pages, with 128 roentgenograms, 3 drawings, 11 graphs, and 10 tables. Distributed by Acta rheumatologica scandinavica, Stockholm, Sweden, 1958. Paper-bound.

TREATMENT OF MALIGNANT BLOOD DISEASES BY RADIOACTIVE PHOSPHORUS. PART I. CLINICAL ASPECTS. By INGMAR BERGSTRÖM AND ERIK LINDGREN. From the Roentgen Department and the Medical Clinic of Serafimerlasarettet, Stockholm. Translated by Frederick A. L. Charlesworth. Supplement 150, Part I, to Acta radiologica. A monograph of 108 pages, with figures and tables. Published by Acta radiologica, Stockholm 2, Sweden. Price Sw. Kr. 25:—.

TREATMENT OF MALIGNANT BLOOD DISEASES BY RADIOACTIVE PHOSPHORUS. PART II. HEMATOLOGICAL ASPECTS. By INGMAR BERGSTRÖM. From the Roentgen Department and the Medical

Clinic of Serafimerlasarettet, Stockholm. Translated by Frederick A. L. Charlesworth. Supplement 150, Part II, to Acta radiologica. A monograph of 98 pages, with 3 figures and 66 charts. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 25:—.

ÜBER DAS VORKOMMEN VON HIATUSHERNIEN UND KARDIAINSUFFIZIENZ IN VERBINDUNG MIT PLEURASCHWARTE. By OTSO KUOSMANEN. From the WIHURI RESEARCH INSTITUTE, HELSINKI, and the Institute for Legal Medicine of the University of Helsinki, Helsinki, Finland. Supplement 153 to Acta radiologica. A monograph of 76 pages, with 14 roentgenograms, 5 drawings, and 22 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1957. Price Sw. Kr. 20:—.

NORMALE UND PATHOLOGISCHE ENTWICKLUNG DES MENSCHLICHEN HERZENS: URSACHEN UND MECHANISMEN TYPISCHER UND ATYPISCHER HERZFORMBILDUNGEN DARGESTELLT AUF GRUND NEUER BEFUNDE. By Priv.-Doz. Dr. KLAUS GOERTTLER, Pathologisches Instituts der Universität Kiel. Heft 3, Zwanglose Abhandlungen aus dem Gebiet der normalen und pathologischen Anatomie. Edited by Prof. Dr. W. Bargmann, Direktor des Anatomischen Instituts der Universität Kiel, and Prof. Dr. W. Doerr, Direktor des Pathologischen Instituts der Universität Kiel. A monograph of 124 pages, with 54 figures. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1958. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 33.—($7.85)

MEDIZINISCHE RÖNTGENTECHNIK: LEHRBUCH FÜR MEDIZINISCH-TECHNISCHE ASSISTENTINNEN, ÄRZTE UND STUDIERENDE IN ZWEI TEILEN. Edited by Prof. Dr. HERBERT SCHOEN, Karlsruhe, with the assistance of Dipl.-Physiker Dr. ERICH BUNDE, MUNICH, Priv.-Doz. Dr. WALTER FROMMHOLD, Berlin, Dr. VIKTOR LOECK, Munich, Dr. DETLEV SCHOEN, Tübingen. II. PHYSIKALISCH-TECHNISCHER TEIL. 1. GRUNDLAGEN DER STRAHLENDIAGNOSTIK UND STRAHLENTHERAPIE (MIT APPARATEKUNDE). By ERICH BUNDE, Dipl.-Physiker, Munich. 2. RÖENTGENOPHOTOGRAPHIE. By Dr. VIKTOR LOECK, Munich. Second edition. A volume of 464 pages, with 281 figures. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1958. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 48.—($11.40)

WESEN UND BEDEUTUNG DER ENCHONDRALEN DYSOSTOSEN. By Privatdozent Dr. med. HANS MAU, Heidelberg. With a Foreword by Prof. Dr. K. Lindemann, Heidelberg. A monograph of 220 pages, with 83 figures. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 1958. Distributed in the United States and Canada by Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 27—($6.40).

RADIOLOGIE OSTÉO-ARTICULAIRE (1). LA MÉNISCOGRAPHIE EN SÉRIE DU GENOU. By Drs. S. DE SÈZE, A. DJIAN, R. CALOP, AND H. PUCHOT. Travail du Centre de rhumatologie Viggo-Pétersen de l'Hôpital Lariboisière et de l'Hôpital Franco-Musulman. Numéro spécial des "Monographies médicales et scientifiques," janvier 1958, n° 8. A monograph of 64 pages, with numerous figures. Published by Monographies médicales et scientifiques, 30, rue des Saints-Pères, Paris 7, France, 1958. Price 900 francs.

Book Reviews

ORTHOPEDIC SURGERY IN INFANCY AND CHILDHOOD. By ALBERT BARNETT FERGUSON, JR., B.A., M.D., Silver Associate Professor Orthopedic Surgery, University of Pittsburgh; Chief of Orthopedic Service, University of Pittsburgh Medical Center; Senior Staff, Children's, Presbyterian and St. Margaret's Hospitals, Pittsburgh; Chairman, Medical Advisory Board, Harmarville Rehabilitation Center; Consultant, Orthopedic Surgery, U. S. Veterans Hospital, Oakland and Green County Memorial Hospital, Waynesburg. A volume of 508 pages, with 504 illustrations. Published by Williams & Wilkins Co., Baltimore, 1957. Price $15.00.

This fine text provides a long awaited compendium on the orthopedic problems of the young, excluding fractures, but including many types of traumatic lesions such as hand injuries. It is arranged regionally in its first portion, the latter half being divided into "Affections of Bone," "Affections of Muscle," "Neurogenic Affections," and "Malignant Tumors of Bone." A large number of excellent photographs and diagrams are used effectively to illustrate the text. Many good roentgenographic reproductions are provided, and the importance of soft-tissue interpretation is emphasized, as in synovitis of the hip, early osteomyelitis, joint affections, and the painful heel.

A good but brief section on scoliosis presents clearly the methods of measuring and recording the curves. Something might have been said, however, about the very widely used Risser localizer jacket. Affections of bone are well covered by Albert Ferguson, Sr.

One can find points of minor disagreement. Nonosteogenic fibroma is not always a lesion of

no significance and has not infrequently resulted in pathological fracture. According to the recent evidence of Kaplan, discoid meniscus is not congenital, as described by the author.

In general, one finds oneself in broad agreement with the principles outlined but regrets that the topics to be covered are so numerous that the author was not permitted to be more detailed in many areas. Also, the publication is marred by frequent typographical errors. This text can be highly recommended for all persons interested in Orthopedic Surgery and it will become a "must" for the Orthopedic Resident.

LEHRBUCH DER RÖNTGENOLOGISCHEN DIFFERENTIALDIAGNOSTIK. BAND I: ERKRANKUNGEN DER BRUSTORGANE. By Prof. Dr. WERNER TESCHENDORF, Cologne, with the assistance of Priv.-Doz. Dr. P. THURN, Bonn. A volume of 1,184 pages, with 1,138 figures, mostly roentgenograms. Published by Georg Thieme Verlag, Herdweg 63, (14a) Stuttgart, Germany, 4th ed., 1958. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price DM 210.—($50.00)

Volume I of Teschendorf's textbook on roentgen differential diagnosis concerns diseases of the lung, the heart, the esophagus, and the diaphragm, arranged in the same sequence in this new fourth edition as in the earlier ones. The predominant philosophy is still one of differential diagnosis in which the roentgen findings are the starting point, followed by something in the nature of detective work to determine which clinical diagnosis fits the roentgen picture. Of necessity there are exceptions which are handled and given space under suitable headings, such as childhood tuberculosis, aneurysm, and neoplasm.

Many improvements over the third edition are to be noted. The volume is 232 pages longer, with a total of 1184 pages. On the first page, one now finds a list of the methods of roentgen examination of the lungs. Farther on, the diagrams of the lung segments have been markedly improved and the nomenclature is brought up to date. Middle lobe syndrome is represented as a complete topic. The coverage of virus pneumonia is extensive and in keeping with the increased incidence of the disease and its various manifestations. An entire division of the book concerns transverse tomography. One of the beautiful illustrations in this section is that of an aspergilloma of the lung. The section on pneumomediastinum has been expanded, with greater emphasis on the diagnostic possibilities of this modality. Since angiocardiography has become a major method of cardiac diagnosis, illustrations are here numerous. In this connection, the plain films showing the tip of the catheter in the various cardiac chambers incident to cardiac catheterization should prove extremely valuable. A new division on aberrant pulmonary veins, entitled "Incorrect Return of the Pulmonary Veins to the Heart," is excellent but has unfortunately escaped indexing other than in its marginal reference. The text on the tetralogy and the trilogy of Fallot has grown from a few paragraphs to thirteen admirably illustrated pages. New diagrams of aortic arch abnormalities have been drawn.

This is the same excellent textbook of roentgen diagnosis in a markedly expanded form. One can have no hesitancy in recommending that it be used both by the experienced radiologist and by the student.

SELEKTIVE LUNGENANGIOGRAPHIE IN DER PRÄOPERATIVEN DIAGNOSTIK UND IN DER INNEREN KLINIK. By Prof. Dr. WILHELM BOLT, Medizinische Universitätsklinik Köln, Prof. Dr. WERNER FORSSMANN, Bad Kreuznach, and Dr. HANS RINK, Landesmed.-Direktor, Rheinisches Landeskrankenhaus Marienheide. With a Foreword by Prof. Dr. h.c. H. W. Knipping, Direktor der Medizinischen Universitätsklinik Köln. A volume of 200 pages, with 205 figures. Published by Georg Thieme Verlag, (14a) Stuttgart, Germany, 1957. Distributed in the United States and Canada by the Intercontinental Medical Book Corporation, New York 16, N. Y. Price, DM 54.—($12.85).

In this excellent monograph the problem of selective angiographic examinations of the vascular tree of the lung is thoroughly discussed and documented by about 2,000 cases. After a short introduction, preface, and historical review of heart catheterization and angiocardiography, the book is subdivided into two main sections, one dealing with the general aspects of the problem (29 pages) and a special section (131 pages) concerned with findings encountered in various diseases.

In the first part, the clinical indications and principles of various selective angiographic technics and topography are discussed. On page 23, in an anatomical drawing of the various segmental arteries, there seems to be some error in the marking of the lower lobes, where A_9 should be marked A_8 and *vice versa*. Subsequently, the authors discuss the general criteria for recognition of angiograms showing pathological changes.

In the second section of the work, a short introduction, dealing with heart and lung disease, is followed by discussion of the findings in different types of atelectasis, pleural disease, emphysema, silicosis, lobar pneumonia, lung tumors, tuberculosis, findings in angiograms after surgical intervention, changes in primary pulmonary sclerosis, arteriovenous aneurysm, acquired and congenital heart disease such as patent ductus arteriosus, ventricular and atrial septal defects, and anomalies of veins. The authors comment on the application and cor-

relation of selective angiograms, especially spot bronchograms. After a short summary, an extensive bibliography is provided.

This monograph contains excellent roentgenographic reproductions and tables giving all the necessary information pertaining to the 96 cases which are discussed. It is a valuable work which should be recommended to radiologists and other physicians who are interested in the pulmonary circulation.

L'INTESTIN GRELE NORMAL ET PATHOLOGIQUE (ÉTUDE CLINIQUE ET RADIOLOGIQUE). By E. CHÉRIGIÉ, P. HILLEMAND, CH. PROUX, AND R. BOURDON. A volume of 578 pages, with 556 figures. Published by Expansion Scientifique Française, 15 Rue St.-Benoit, Paris 6°, France, 1957.

This is a beautifully printed volume on diseases of the small intestine. Aware of the general lack of interest on the part of radiologists in the small bowel, as contrasted with the stomach and colon, the authors have given this structure special attention over the past seven years, and the present volume is a summary of their labors and experiences.

Chapters are devoted to technics, normal findings, anomalies, and most of the medical and surgical diseases that may involve the small intestine. There are over five hundred illustrations of excellent quality, many with clarifying line drawings, bearing legends in French, English, and Spanish. At the end of each chapter are adequate summaries in these tongues.

Quite apart from the text, the illustrations comprise a most desirable atlas of the radiology of the small intestine. This work can be recommended to all interested in this field.

IN MEMORIAM

Richard Anthony Rendich, M. D.

The following notice of the death of Dr. Richard A. Rendich is presented with the apologies of Radiology for its late appearance. The illness of Dr. Ehrenpreiss, who undertook its preparation, and of Mrs. Rendich, who supplied some of the information, combined to prevent earlier publication.

Dr. Richard Anthony Rendich, internationally known roentgenologist, died in Port Washington Hospital, Port Washington, N. Y., on Oct. 12, 1956. He had retired from active practice in 1943.

Dr. Rendich was born in 1891 in Brooklyn. N. Y. He attended St. Stephen and St. Francis Xavier preparatory schools in Brooklyn and was graduated in 1914 from Fordham Medical School. He served his internship in Kings County Hospital until his call to the Army, where he was roentgenologist with Base Hospital 37. Discharged with the rank of Captain, he became associated with the X-ray Department of Bellevue and Allied Hospitals, remaining there as Assistant Director until his appointment as Director of Roentgenology in Kings County Hospital, Brooklyn, a position he continued to hold until illness forced his retirement.

In 1930, Dr. Rendich became Director of Radiology in the Department of Hospitals of the City of New York, with its twenty-odd x-ray departments. He set up the first adequate standards for these departments and organized the first film library.

Dr. Rendich contributed extensively to the radiological literature, some twenty-five papers bearing his name. He was especially known for his mucosal studies of the stomach. Under his keen analytical eye, this examination was advanced and simplified by the use of a single teaspoonful of the conventional barium-water-mucilage mixture, which outlined most of the gastric mucosa within a period of five or ten minutes, without the necessity of fluoroscopy or compression studies.

As a teacher, in the Long Island College of Medicine, Dr. Rendich inspired a host of students and residents by his keen judgment and modest personality. He was a diplomate of the American Board of Radiology, a fellow of the American College of Radiology, and a member of the Radiological Society of North America. He was a founder and past president of the Catholic Physicians' Guild of the Brooklyn Diocese and a founder of the Family Communion Crusade. He was a Knight of St. Gregory. His death is a loss to his church, his profession, and to his friends. Beside his widow, Mrs Claire Jobin Rendich, he is survived by six brothers and three sisters.

BERNARD EHRENPREISS, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert L. Brown, M.D., P. O. Box 459, Emory University, Ga.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, C. Allen Good, M.D., Rochester, Minn.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

ASSOCIATION OF UNIVERSITY RADIOLOGISTS. *Secretary-Treasurer*, Paul Riemenschneider, M.D., Department of Radiology, Medical College, State University of New York, Syracuse, N. Y.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, T. Leucutia, M.D., 10 Peterboro, Detroit 1, Mich.

SOCIETY OF NUCLEAR MEDICINE. *Secretary*, Robert W. Lackey, M.D., 452 Metropolitan Bldg., Denver 2, Colo.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Garland Wood, Jr., M.D., Medical College of Alabama, Birmingham 3.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 1313 N. Second St., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, E. A. Mendelsohn, M.D., Holt-Krock Clinic, Fort Smith. Meets quarterly.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, William H. Graham, M.D., 630 E. Santa Clara St., San Jose.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Putnam C. Kennedy, M.D., 540 N. Central Ave., Glendale 3. Meets second Wednesday, September, November, March, April, and June, Los Angeles County Medical Association Building.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, LeRoy K. Mills, M.D., 3235 Fair Oaks Blvd., Carmichael. Meets last Monday of every other month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, Harold P. Tompkins, M.D., 658 S. Westlake, Los Angeles 57.

REDWOOD EMPIRE RADIOLOGICAL SOCIETY. *Secretary*, Lee E. Titus, M.D., 164 W. Napa Street, Sonoma, Calif. Meets second Monday every other month.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, Stanley A. Moore, M.D., 2466 First Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irma Smith, M.D., 450 Sutter St., San Francisco 8. Meets quarterly, at Grison's Steak House.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Stanford B. Rossiter, M.D., 1111 University Dr., Menlo Park. Meets second Wednesday every month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, John H. Heald, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:30 P.M., Children's Hospital, September through June.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Lorenz R. Wurtzebach, M.D., 601 E. Nineteenth Ave., Denver 5. Meets monthly, third Friday, at Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, Ralph J. Littwin, M.D., Bristol Hospital, Bristol. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary-Treasurer*, Charles E. Bickham, Jr., M.D., 1835 Eye St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell D. D. Hoover, M.D., 1717 N. Flagler Dr., West Palm Beach. Meets in April and October.

GREATER MIAMI RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, George P. Daurelle, M.D., Jackson Memorial Hospital, Miami 36. Meets monthly, third Wednesday, 8:00 P.M., at Jackson Memorial Hospital.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Marvin Harlan Johnston, M.D., Five Points Medical Center, Jacksonville 4. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Luther Clements, Jr., M.D., 35 Linden Ave., N.E., Atlanta 8. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Herbert M. Olnick, M.D., 417 Persons Bldg.,

Macon, Ga. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary-Treasurer*, Jun-chu'an Wang, M.D., The Queen's Hospital, Honolulu 9. Meets third Monday of each month.

Idaho

IDAHO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Charles R. McWilliams, M.D., Twin Falls.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary-Treasurer*, Arthur S. J. Petersen, M.D., 11406 S. Parnell Ave., Chicago 28. Meets at the Sheraton Hotel, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, William Meszaros, M.D., 1825 W. Harrison St., Chicago.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, Chester A. Stayton, Jr., M.D., 313 Hume Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). *Secretary-Treasurer*, Robert E. Beck, M.D., 600 Mary St., Evansville, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, James R. Stark, M.D., 3244 East Douglas St., Wichita 8. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert H. Akers, M.D., 1405 West Broadway, Louisville 3. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, Seymour Ochsner, M.D., Ochsner Clinic, New Orleans 15.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Francis J. O'Connor, M.D., Augusta General Hospital, Augusta. Meets in June, October, December, and April.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, James K. V. Willson, M.D., 1100 N. Charles St., Baltimore 1. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Nathan B. Hyman, M.D., 1805 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, Joseph O. Reed, Jr., M.D., 3825 Brush, Detroit 1. Meets first Thursday, October to May, Wayne County Medical Society rooms.

UPPER PENINSULA RADIOLOGICAL SOCIETY. *Secretary*, Arthur Gonty, M.D., Menominee. Meets quarterly.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, O. J. Baggenstoss, M.D., 1953 Medical Arts Bldg., Minneapolis 2. Meets three times a year.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert P. Henderson, M.D., 316 Medical Arts Bldg., Jackson. Meets monthly, on third Thursday, 6:00 P.M., at Hotel Edwards, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary-Treasurer*, Lewis Allen, M.D., 907 N. 7th St., Kansas City 1, Kans. Meets last Friday of each month.

GREATER ST. LOUIS RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Charles J. Cherre, M.D., 462 N. Taylor, St. Louis 8. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur T. Austin, M.D., 104 Doctors Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wayne K. Tice, M.D., 128 N. 13th St., Lincoln 8. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGIC SOCIETY. *Secretary-Treasurer*, Paul J. Kingston, M.D., 114 Woodland St., Hartford, Conn. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, John E. Gary, M.D., 1180 Beacon St., Brookline 46, Mass. Meets monthly on third Friday, October through May, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary-Treasurer*, Paul Y. Hasserjian, M.D., 1470 Elm St., Manchester.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Dr. Andrew P. Dedick, Jr ., M.D., 67 E. Front St., Red Bank. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BROOKLYN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Solomon Schwartz, M.D., 555 Prospect Place, Brooklyn 38. Meets first Thursday, October through May.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary*, Charles Bernstein, M.D., 685 Delaware Ave., Buffalo 9. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Joseph A. Head, M.D., University Hospital, 150 Marshall St., Syracuse. Meets second Monday, October through May.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. P. Naidorf, M.D., 411 Parkside Ave., Brooklyn 26. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Jerome Zwanger, M.D., 126 Hicksville Road, Massapequa. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold G. Jacobson, M.D., Montefiore Hospital, 210th St. and Bainbridge Ave., New York 67, N. Y.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving Van Woert, Jr., M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April; annual meeting, May or June.

RADIOLOGICAL SOCIETY OF STATE OF NEW YORK. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, John W. Colgan, M.D., 277 Alexander St., Rochester 18. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arnold Myron Wald, M.D., 406 Boston Post Road, Port Chester. Meets third Tuesday of January and October and as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, William H. Sprunt, M.D., North Carolina Memorial Hospital, Chapel Hill, N. C. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Marianne Wallis, M.D., Minot. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary*, Francis C. Curtzwiler, M.D., 421 Michigan St., Toledo.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Arthur R. Cohen, M.D., 41 S. Grant Ave., Columbus. Meets second Thursday, October, November, January, March, and May, 6:30 P.M., Fort Hayes Hotel, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Frederick A. Rose, M.D., 2065 Adelbert Road, Cleveland 6. Meets at 7:00 P.M., fourth Monday, October, November, January, February, March and April, at Tudor Arms Hotel.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Warner A. Peck, Jr., M.D., 441 Vine St., Cincinnati 2. Meets first Monday, September through May, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, G. F. Johnson, M.D., 1030 Reibold Bldg., Dayton 2, Ohio. Meets monthly, second Thursday, Miami Valley Hospital, Dayton.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary*, Edmond H. Kalmon, Jr., M.D., 300 Northwest 12th St., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, C. V. Allen, M.D., 9855 S.W. Hawthorne Lane, Portland. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Arch Colbrunn, M.D., 1919 Royal Oak Drive, Roseburg, Ore. Meets in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary*, Walter P. Bitner, M.D., 234 State St., Harrisburg. Next annual meeting, April 24–25, 1959, Harrisburg.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Roderick L. Tondreau, M.D., 3400 Spruce St., Philadelphia 4. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary*, Edward M. Schultz, M.D., 3401 Fifth Ave., Pittsburgh 13.

Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 E. Ninth Ave., Denver 20, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary*, Wayne Reeser, M.D., 1600 Ninth Ave., Conway. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

The Southeast

Southern Radiological Conference. *Secretary-Treasurer*, Marshall Eskridge, M.D., 1252 Springhill Ave., Mobile, Ala.

The Southwest

SOUTHWESTERN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Gordon L. Black, M.D., 1501 Arizona Bldg., El Paso, Texas.

Tennessee

MEMPHIS ROENTGEN SOCIETY. *Secretary-Treasurer*, James L. Booth, M.D., 899 Madison Ave., Memphis 3. Meets monthly first Monday, John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James J. Range, M.D., P. O. Box 324, Johnson City. Meets annually with State Medical Association in April.

Texas

DALLAS-FORT WORTH RADIOLOGICAL CLUB. *Secretary*, Albert H. Keene, M.D., 3707 Gaston Ave., Dallas. Meets monthly, third Monday, 6:30 P.M., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Edward Singleton, M.D., 6621 Fannin St., Houston 25. Meets last Monday of each month at the Doctors' Club.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets at Fort Sam Houston Officers' Club, third Wednesday of each month, 6:30 P.M.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, JARRELL E. MILLER, M.D., 3500 Gaston Ave., Dallas. Next meeting in Dallas, Jan. 30–31, 1959.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Kearney, 2nd, M.D., 110 S. Curry St., Phoebus.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wayne A. Chesledon, M.D., 306 Stimson Bldg., Seattle 1. Meets fourth Monday, September through April, at College Club, Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. Paul Elkin, M.D., 515–519, Medical Arts Bldg., Charleston. Meets with State Medical Society, and as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Joseph F. Wepfer, M.D., 5000 W. Chambers St., Milwaukee 10. Meets fourth Monday, October through May, at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Farrell F. Golden, M.D., 5221 Tonyawatha Trail, Madison 4.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary-Treasurer*, Dr. R. B. Díaz Bonnet, Suite 504, Professional Bldg., Santurce, P.R.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Guillaume Gill, M.D.; *Associate Honorary Secretary-Treasurer*, Robert G. Fraser, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTRO-RADIOLOGIE MÉDICALES. *General Secretary*, Louis Ivan Vallée, M.D., Hôpital Saint-Luc, 1058 rue St-Denis, Montreal 18. Meets third Saturday of each month.

L'ASSOCIATION DES RADIOLOGISTS DE LA PROVINCE DE QUEBEC. ASSOCIATION OF RADIOLOGISTS OF THE PROVINCE OF QUEBEC. *Secretary*, Isadore Sedlezky, M.D., 3755 Cote St. Catherine Road, Montreal. Meets four times a year.

TORONTO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, L. R. Harnick, M.D., X-Ray Department, Toronto Western Hospital, 399 Bathurst St. Meets second Monday evening, September to May.

CUBA

SOCIEDAD CUBANA DE RADIOLOGÍA Y FISIOTERAPIA. *Secretary*, Dr. Miguel A. García Plasencia, Hospital Curie, 29 y F, Vedado, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA. *Headquarters*, Calle de Coahuila, Núm. 35, Mexico 7, D. F. *Secretary General*, Dr. Jorge Ceballos Labat. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

PETERSON, HAROLD O. Reliability and Limitations of X-ray Diagnosis of Intracranial Neoplasms 123

MOUNT, LESTER A., AND TAVERAS, JUAN M. Arteriographic Demonstration of the Collateral Circulation of the Cerebral Hemispheres 123

DRORI, JACK B., ET AL. Pineal Gland Displacement in Acute Cerebrovascular Occlusion. Case 124

SILVERMAN, FREDERIC N. Roentgen Standards for Size of the Pituitary Fossa From Infancy Through Adolescence 124

DAVIS, LAWRENCE A., AND DIAMOND, ISRAEL. Metastatic Retinoblastoma as a Cause of Diffuse Intracranial Calcification 124

ROBERTS, R. I. A Cineradiographic Investigation of Pharyngeal Deglutition 124

The Chest

FROMMHOLD, W., AND GAUL, K. E. Selective Bronchography of Apical Lung Segments 124

NADELHAFT, JEROME, AND ELLIS, KENT. Roentgen Appearances of the Lungs in 1,000 Apparently Normal Full Term Newborn Infants 125

ELLIS, KENT, AND NADELHAFT, JEROME. Roentgenographic Findings in Hyaline Membrane Disease in Infants Weighing 2,000 Grams and Over 125

BURKE, RICHARD M., AND WEIR, JAMES A. Nontuberculous Disease Originally Diagnosed Pulmonary Tuberculosis 125

REBER, H. Failures in Photofluorography 126

RIGLER, LEO G. A Roentgen Study of the Evolution of Carcinoma of the Lung 126

MARMORSHTEIN, S. Ia. Roentgenologic Diagnosis of Peripheral Lung Cancer 126

OVERHOLT, RICHARD H., ET AL. Bronchial Adenoma. A Study of 60 Patients with Resections 127

SHAPIRO, HARRISON, AND LOWMAN, ROBERT M. Roentgen Manifestations of Erythema Exudativum Multiforme (Stevens-Johnson Syndrome) 127

LEVIN, HERBERT G. A Case of Chicken-Pox Pneumonia with X-Ray Findings Suggesting Metastatic Carcinoma 127

GÉHER, F. Roentgen Diagnosis and Classification of Pulmonary Paragonimiasis 128

GODFREY, L. B. Aspergillosis of the Lung 128

MENDELOW, HARVEY, AND SLOBODKIN, MORRIS. Aortic-Body Tumor (Chemodectoma) of the Mediastinum 128

The Heart and Blood Vessels

BRODEUR, ARMAND E., ET AL. Abnormalities Seen on Chest Photofluorograms and Diagnosable Heart Disease 129

MCAFEE, JOHN G., AND BIONDETTI, PAOLO. Roentgenologic Follow-up on 150 Consecutive Mitral Commissurotomy Patients 129

SOLOFF, LOUIS A., ET AL. The Size of the Pulmonary Artery in Rheumatic Heart Disease with Isolated Mitral Stenosis and Its Significance 129

PAUL, ROBERT E., ET AL. Intravenous Carbon Dioxide for Intracardiac Gas Contrast in the Roentgen Diagnosis of Pericardial Effusion and Thickening 130

GILSANZ, VICENTE, ET AL. Portal Circulation in Constrictive Pericarditis. Spleen-Lung Ether Time in Relation to Splenoportography Before and After Pericardiectomy 130

PEREIRAS, RAUL, ET AL. Roentgen Diagnosis of Aortic Coarctation in an Unusual So-called Lower or Atypical Region, by Retrograde Aortography; Two Cases 130

STEINBERG, ISRAEL, ET AL. Aneurysmal Dilatation of the Aortic Sinuses in Marfan's Syndrome: Angiocardiographic and Cardiac Catheterization Studies in Identical Twins .. 131

BELCHER, J. R., AND PATTINSON, J. N. Hypoplasia of the Lobar Pulmonary Arteries. Three Cases 131

NABSETH, DONALD C., AND RITVO, MAX. Femoral Arteriography; A Simple and Safe Method 131

SILVERMAN, JACOB J., AND HURWITT, ELLIOTT S. Subcutaneous Rupture of a Popliteal Aneurysm, with a Diagnostic Roentgen Sign. 132

KOSZEWSKI, BOHDAN J., AND HUBBARD, THEODORE F. Pulseless Disease Due to Branchial Arteritis 132

The Digestive System

WORKMAN, JOHN M. Inflation of Esophageal Hernial Sac in the Course of Induced Pneumoperitoneum 132

EUPHRAT, EDWIN J., AND DELMONICO, J. ERNEST, JR. Coexistent Achalasia of the Esophagus and Hiatal Hernia of the Cardiac End of the Stomach 132

WOLF, BERNARD S., AND SHERKOW, CHARLES J. Carman Sign of Ulcerating Gastric Carcinoma 133

ATKINS, LEONARD, ET AL. Correlation of Symptoms With Gastroscopic Findings, X-Ray Findings and Gastroscopic Biopsy in Gastritis 133

BUCHTALA, V. Examination of the Mucous Membrane in Pyloric Stenosis by Catheterization ... 133
PANNHORST, R. Functional X-Ray Symptoms of the Small Intestine in Epidemic Parotitis ... 134
EPSTEIN, BERNARD S. Nonabsorbable Water-Soluble Contrast Mediums; In Diagnosis of Intestinal Obstruction ... 134
EDWARDS, JEFFERSON R., JR., AND RILEY, RICHARD F. Intestinal Obstruction Due to Persimmon Bezoar (Diospyrobezoar) ... 134
DUBERGER, R. L. Enterogenous Cyst of the Duodenum ... 134
SIEBER, WILLIAM K., AND GIRDANY, BERTRAM R. Management of Symptomatic Aganglionic Megacolon in Early Infancy ... 135
SERFAS, LEE S., AND LYTER, CLINTON S. Choledochal Cyst, with a Report of an Intraduodenal Choledochal Cyst ... 135
DEWEESE, MARION S., ET AL. Clinical Appraisal of Percutaneous Splenoportography ... 135

The Musculoskeletal System

MILGRAM, LILLIAN. Skeletal Tuberculosis in Children Treated for Primary and Miliary Tuberculosis ... 136
CAFFEY, JOHN. Cooley's Anemia: A Review of the Roentgenographic Findings in the Skeleton ... 136
ROTENBERG, C., AND MCGEE, A. R. Late Bone Changes in Caisson Disease, with a Case Report ... 137
CURRARINO, GUIDO, ET AL. Hypophosphatasia. 137
GILLANDERS, LEWIS A. Osteogenesis Imperfecta Diagnosed in Utero ... 138
DEL BUONO M. S. Lumbar Myelography in Diagnosis of Disk Hernia ... 139
MATTHIESEN, DON E. Premature Growth Arrest of the Knee Epiphyses ... 139
HULTING, BENGT. Roentgenologic Features of Fracture of the Tibial Tuberosity (Osgood-Schlatter's Disease) ... 139

The Spinal Cord

BOSE, K. S. Dermoid Tumour of the Spinal Cord ... 140

Gynecology and Obstetrics

LEHFELDT, HANS, ET AL. Cineradiography of Female Pelvic Organs. A Preliminary Report on a New Method ... 140
FOCHEM, K. Problems of Contrast Media in Hysterosalpingography ... 140
BERMAN, ROBERT, AND SONNENBLICK, BENJAMIN P. Intravaginal Measurement of Radiation Dose Incident to X-Ray Pelvimetry and Hysterosalpingography ... 140
BLIGH, A. S. Pyelographic Changes in Pregnacy ... 141
KALTREIDER, D. FRANK. Fetopelvic Grading of Breech Presentations ... 141
KROL, EDWARD J., ET AL. Mobile Lithopedion—A Chance Discovery in Routine X-Ray Examination ... 141

The Genitourinary System

GREENWOOD, F. G. Cineradiography in Urinary Tuberculosis ... 142
MENASHE, VICTOR, AND SMITH, D. R. Apparently Unilateral Polycystic Kidney. A Cause for Abdominal Calcific Shadows ... 142
ANNAMUNTHODO, H., AND HUTCHINGS, R. F. Nephroblastoma (Wilms' Tumor); Case ... 142
BARTLEY, OSBORNE. Hypernephroma in a Pelvic Kidney Demonstrated by Angiography. Case ... 142
ZOLLINGER, H. U. Thorotrast Damage of Kidneys with Hypertension ... 142
FULTON, HAROLD. Delayed Cystography in Children ... 143
GANEM, EMIL J., ET AL. The Roentgenographic Diagnosis of Cystitis Emphysematosa ... 143

The Adrenals

GIRAUD, M., ET AL. Radiologic and Stratigraphic Study of Adrenal Tumors; 11 Cases, 3 Bilateral ... 143

Technic

IVANOV, G., ET AL. Tomokymography ... 143
VUORINEN, PEKKA. Segmental Roentgenography by Means of a Standard Tomographic Device. Preliminary Report ... 143
PAATERO, YRJÖ V. Pantomography of Spherical Layers ... 144
LANDES, RALPH R., AND RANSOM, CHARLES L. Technique for the Use of Carbon Dioxide in Presacral Retroperitoneal Pneumography ... 144
SPIEGLER, G., ET AL. High Contrast: A Potential Source of Radiographic Error ... 144
GROSSMANN, ERWIN E., AND THORNFELDT, PAUL R. Red Glass X-Ray Spectacles ... 144

Miscellaneous

HANDSCHUHMACHER, CHRISTIAN-PETER, AND MAURER, HANS-JOACHIM. Incidence of Metastasis to Lungs and Skeleton in Breast Carcinoma of the Female Genitalia ... 144
CIMMINO, C. V. Modification (Pharmacogenic?) of Subphrenic Abscess ... 145
KINCAID, OWINGS, W., ET AL. Neuroblastoma: A Roentgenologic and Pathologic Study ... 145
SAMPSON, D. ALAN. Radiology under Blue Shield and Blue Cross in Pennsylvania ... 146

RADIOTHERAPY

MARTIN, CHARLES L. Is Radium Still Needed in Cancer Therapy? ... 146
SCHWENKENBECHER, HELLMUT. Combination of Roentgen Rays and Mitomen in the Treatment of Advanced Malignant Neoplasms ... 147

ZIMMERMAN, HARRY M. The Natural History of Intracranial Neoplasms, with Special Reference to the Gliomas..... 147
LEDERMAN, M. Technique of Radiation Treatment of Orbital Tumours..... 148
STRUBEN, W. H. Malignant Tumors of Paranasal Sinuses; Treatment and Results..... 148
FRIEDBERG, STANTON A., ET AL. Malignant Lymphomas of the Pharynx..... 148
SCHWAB, WERNER, ET AL. Experiences in the Treatment of Malignant Tumors of the Epipharynx, Tongue and Tonsils, Based on Admissions to the Heidelberg University Ear, Nose and Throat Clinic in the Past Ten Years 149
WU, CHING. Necropsy Studies in 16 Cases of Bronchogenic Cancer Treated by 2 Million Volt Roentgen Ray..... 149
LATOUR, J. P. A., ET AL. Preclinical Carcinoma of the Cervix..... 149
FLETCHER, GILBERT H. Can the Cure Rate of Squamous Cell Carcinoma of the Uterine Cervix Be Improved?..... 150
RUMMEL, ALFONS. Treatment of Carcinoma of the Vulva at the University of Würzburg Gynecological Clinic from 1947 to 1951..... 150
ZUPPINGER, A., AND RENFER, H. R. Roentgen Therapy of Osteogenic Sarcoma..... 151
EBENIUS, BERTIL, ET AL. Radiation Therapy in Vernal Conjunctivitis..... 151
ROSSELET, ED., AND ROSSELET, P.-J. Exophthalmos and Radiotherapy..... 152
BURFORD, E. H., AND BURFORD, C. E. Combined Therapy for Peyronie's Disease..... 152
MORRISON, MARGARET T., ET AL. Some Measured Rotation Distributions for 250 kV Therapy..... 152
HAYNES, ROBERT H., AND FROESE, GERD. Idealized Body Contours in Rotation Dosimetry. 152
KAHR, E. Measurement Results in Radiotherapy Applied Through a Plaster Bandage. 153
STEPHENS-NEWSHAM, L. G., AND LA PALME, J. Small Probe Dosimeters..... 153
THOMAS, E. DONNALL, ET AL. Intravenous Infusion of Bone Marrow in Patients Receiving Radiation and Chemotherapy..... 153

RADIOISOTOPES

REEVES, JOHN D. Clinical Applications of Radioactive Isotopes..... 153
PEYTON, WILLIAM T. Isotope Localization in Brain Tumors..... 154
RUBENFELD, SIDNEY, ET AL. The Radioiodine Profile in the Diagnosis of Thyroid Disease.. 154
FERGUSON, MARION H., ET AL. The Salivary Secretion of Iodide in Hypothyroidism..... 154
READ, RAYMOND C., AND GILBERTSEN, SIGRID. Radioactive Sodium Chromate and the Measurement of Red Cell and Plasma Volume in Man..... 154

RADIATION EFFECTS—PROTECTION

TOTTEN, ROBERT S., ET AL. Pre-Existing Roentgen-Ray Dermatitis in Patients with Skin Cancer..... 155
SOWBY, F. D. Dose to the Gonads During Diagnostic Procedures..... 155
STANFORD, R. W. The Use of Cones and Filters to Reduce Patient Dosage in Diagnostic Radiology..... 155
CEDERLUND, J., ET AL. Radiation Hazards During Radon Treatment of Eye Lesions..... 156
LOFSTROM, J. E., ET AL. The Treatment of Nausea Following Therapeutic Irradiation.. 156
CONGDON, C. C., AND URSO, IRENE S. Homologous Bone Marrow in the Treatment of Radiation Injury in Mice..... 156

ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Reliability and Limitations of X-ray Diagnosis of Intracranial Neoplasms. Harold O. Peterson. Am. J. Surg. **93:** 941–945, June 1957. (25 West 45th St., St. Paul 3, Minn.)

In all patients in whom a brain tumor is suspected, plain films of the skull—six views as a minimum—should be obtained before other more complicated procedures are undertaken. About 40 per cent of those with tumor will show some abnormality on these films.

The roentgen findings of brain tumors on plain films can be divided into three broad categories:

(1) *Roentgen Evidence of Increased Intracranial Pressure:* In the adult this is afforded primarily by decalcification, which is most easily detected in the region of the sella, the dorsum sella, and occasionally the wings of the sphenoid and orbital roofs. In children, the first signs of increased pressure are spreading or separation of the sutures which is usually recognized first in the coronal suture, then in the sagittal, and finally in the lambdoid suture.

(2) *Displacement of Normal Structure:* A shift of the pineal body to one side or the other, of more than 3 mm., usually indicates a space-taking lesion on the opposite side. A pineal shift in the anteroposterior or vertical direction is more difficult to determine and the significance is less clear.

(3) *Localizing Findings:* The following findings may permit accurate localization on the plain film: (1) calcification in the tumor, (2) bone production, (3) bone destruction, and (4) increased vascularity in the skull. Calcification occurs in 10 to 15 per cent of all tumors, in the form of large dense masses of small discrete punctate collections or lineal streaks. Craniopharyngiomas have an incidence of calcification of 60 to 70 per cent and oligodendrogliomas of about 50 per cent; calcification in glioblastoma multiforme is quite rare.

Bone production arising from the inner table of the skull or the base of the skull occurs fairly often with a meningioma, which is the only type of brain tumor which can stimulate bone production. Bone destruction may be due to direct pressure, erosion, or invasion by the tumor.

Increased vascularity of the bones of the calvarium is occasionally found in association with meningiomas but, in view of the wide variation in the normal vascularity of the skull, one should be cautious in interpreting vascular markings as abnormal.

Air studies—ventriculography and encephalography—result in accurate localization of most intracranial space-taking lesions. In general, there are four ways in which lesions can be localized following injections of gas: displacement and deformity of the ventricular system; obstruction of the flow of ventricular fluid, resulting in a uniform enlargement of the lateral ventricles; demonstration of a mass within the ventricles or protruding into the lumen so that at least a part is clearly outlined by gas; finally actual entrance of the gas into the neoplasm, as in cystic tumors which have broken through into the ventricles or into the subarachnoid spaces.

Cerebral angiography has made a great contribution to the demonstration of vascular lesions such as aneurysms, vascular thrombosis, and arteriovenous malformations. In many instances angiography is preferable to pneumography in the visualization of tumors, which may be localized by displacement of blood vessels and delineation of the characteristic vascular pattern of the neoplasm itself. The two types of lesions which produce the most characteristic vascular pattern are the meningiomas and the glioblastomas.

Summing up, the author states that approximately 15 to 20 per cent of all brain tumors can be localized on the plain film; pneumography may be correct in 90 to 95 per cent, and angiography in 70 to 80 per cent.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Arteriographic Demonstration of the Collateral Circulation of the Cerebral Hemispheres. Lester A. Mount and Juan M. Taveras. Arch. Neurol. **78:** 235–253, September 1957. (Neurological Institute, 700 W. 168th St., New York, N. Y.)

The authors present their observations on the collateral circulation of the cerebral hemispheres demonstrated by cerebral angiography. Seriographic films were obtained on 42 patients who had undergone surgical therapy for intracranial aneurysms and on 30 patients who had thrombosis of the internal carotid artery or one of its branches.

The authors summarize their findings as follows:

"(1) The collateral circulation of the brain is by way of the circle of Willis, by anastomoses of the branches of the anterior, middle, and posterior cerebral arteries with each other, and by anastomoses between the external and the internal carotid artery. . . .

"(2) While the circle of Willis is the most important source of collateral circulation and its anterior part is the dominant contributor, it is extremely variable, since it is usually irregularly developed. According to Riggs, the circle of Willis is complete and conforms to the so-called normal pattern in only 18 per cent of cases.

"(3) Direct anastomoses of the anterior middle and posterior cerebral arteries with each other have been demonstrated arteriographically. . . .

"There are direct and end-to-end anastomoses or smaller connecting channels as follows:

"(*a*) Between the anterior and the middle cerebral arteries: the frontopolar with the orbitofrontal; the anterior, middle, and posterior internal frontal with the orbitofrontal; the posterior internal frontal with the pre-Rolandic; the paracentral with the Rolandic, and the precuneal with the post-Rolandic.

"(*b*) Between the anterior and posterior cerebral: the precuneal and pericallosal with the parieto-occipital.

"(*c*) Between the posterior cerebral and the middle cerebral: the parieto-occipital with the posterior parietal and angular; the calcarine and the posterior temporal with the posterior temporal of the middle cerebral, and the anterior temporal branches of the two arteries.

"(*d*) Among various branches of both anterior cerebral arteries, in addition to the anterior communicating artery.

"(4) There are communications between the external and internal carotid arteries and their branches by way of the ophthalmic, by back-flow from the external

into the internal carotid, by anastomoses between middle meningeal and the meningeal branch of the internal carotid and *via* rete mirabile."

Fifteen roentgenograms; 2 photographs.

THEODORE E. KEATS, M.D.
University of Missouri

Pineal Gland Displacement in Acute Cerebrovascular Occlusion. Report of a Case. Jack B. Drori, Samuel Tartakoff, and Marjorie J. LeMay. Arch. Neurol. **78:** 228–234, September 1957. (150 S. Huntington Ave., Boston 30, Mass.)

The authors report a case of unilateral cerebral edema, associated with an infarction due to an occlusion of the left middle cerebral artery, in which the pineal gland was first shifted 5 mm. and then 7 mm. to the contralateral side, reverting after fifteen days to its normal midline position. Six months later a pneumoencephalogram demonstrated marked cerebral atrophy at the site of the infarct.

Ten cases, previously recorded by various authors, in which the pineal gland or the ventricular or the arterial system was displaced to the contralateral side in the presence of vascular occlusion are summarized.

Patients with occlusive cerebrovascular disease may present findings simulating an intracranial space-occupying lesion and thereby occasionally undergo needless craniotomy. The clinical course and carotid angiography may help in establishing the correct diagnosis.

Six roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Roentgen Standards for Size of the Pituitary Fossa from Infancy through Adolescence. Frederic N. Silverman. Am. J. Roentgenol. **78:** 451–460, September 1957. (Children's Hospital, Cincinnati 29, Ohio)

Graphs are presented which define the range of normal variation in area of the pituitary fossa with respect to age and stature in either sex. These were compiled from a series of normal lateral skull films obtained in growth studies of 168 boys and 152 girls from the age of one month to eighteen years. Over 4,000 lateral films of the skull were examined with a compensating polar planimeter to attain accuracy in area measurements. Conversion tables are included so that a mean area may be computed from length and depth measurements of the fossa.

Three roentgenograms; 9 drawings; 4 tables.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

Metastatic Retinoblastoma as a Cause of Diffuse Intracranial Calcification. Lawrence A. Davis and Israel Diamond. Am. J. Roentgenol. **78:** 437–439, September 1957. (L. A. D., 226 East Chestnut St., Louisville, Ky.)

A case of retinoblastoma with extension into the brain and subarachnoid areas in a four-month-old infant is described. Extensive intracerebral calcifications, with hydrocephalus, were roentgenographically demonstrated. The calcifications were punctate and in the illustrations are seen to be principally in the left frontoparietal region, though the primary site of the tumor was the right eye.

Calcification has been identified in as high as 75 per cent of cases of retinoblastoma, but has been confined to the orbit in heretofore reported cases. Toxoplasmosis and cytomegalic inclusion disease may also produce intracranial calcification in young infants.

Photographs of autopsy specimens showing extensive metastases and a photomicrograph of the tumor are reproduced.

GEORGE L. SACKETT, M.D.
Cleveland, Ohio

A Cineradiographic Investigation of Pharyngeal Deglutition. R. I. Roberts. Brit. J. Radiol. **30:** 449–460, September 1957. (Odstock Hospital, Salisbury, Wiltshire, England)

An account is given of pharyngeal deglutition based upon a cineradiographic study of 100 normal subjects between the ages of seventeen and thirty-five. Swallowing is described as a sequence of co-ordinated movements bearing on the bolus during its progress. The forces propelling the bolus are described in detail. A separate section is devoted to the movements on continuous swallowing and another to those returning the parts to their resting position. The descriptions are somewhat lengthy and do not lend themselves well to abstracting. This article should be consulted for details by those interested in this application of cineradiography.

Standard radiographic equipment was used and a camera constructed by hospital engineers for indirect cineradiography at 25 frames per second. Ilford HPX 35-mm. film was utilized on account of its speed. The lateral projection of the neck provided the most information because it included a simple view of the whole tract and the bolus was seen to move, whether backward or downward, across the line of sight and was constantly under observation.

It is hoped that improved knowledge regarding the function and behavior of the soft palate and related parts may facilitate further progress in surgery for congenital defects that interfere with the swallowing function.

Twenty roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

THE CHEST

Selective Bronchography of Apical Lung Segments. W. Frommhold and K. E. Gaul. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 307–312, September 1957. (In German) (W. F., Falkenried 16, Berlin-Dahlem, Germany)

For the clear demonstration of the bronchi of apical pulmonary segments, it is essential that coughing be suppressed in order to avoid flooding of the field by radiopaque material in other bronchial ramifications. This can be accomplished by proper pharmacological preparation of the patient and by mechanical prevention of back flow of the contrast medium.

Morphine has been considered by many to be contraindicated for pharmacological preparation because of its depressant effect upon the respiration. Recently, mainly through the efforts of American investigators, morphine antagonists such as Lorphan have been described, which given with the narcotic will completely abolish these unfavorable reactions. The authors have obtained excellent results with the following procedure: Atropine to suppress the bronchial secretion and phenobarbital to reduce the toxicity of the local anesthetic are given first. Then, thirty minutes prior to bron-

chography, 2 mg. of Dromoran (the narcotic) with 0.2 mg. of Lorphan are injected hypodermically. [Both of these drugs, made by Roche, are available in the United States, Dromoran in the form of Levo-Dromoran—W. A. M.]

To prevent reflux of the contrast material, the authors use a specially made Metras catheter, the lower end of which has an inherent curve of about half a circle, with a diameter corresponding approximately to the distance from the trachea to the apex of the lung. The tip of the catheter is made of very soft rubber. A straight metal sound is placed in the catheter to permit its introduction into the larynx and the trachea. When the upper bronchus is reached, the sound is gradually withdrawn, and the lower end of the catheter will turn upward due to its inherent curve until the tip is directed into the desired field. The soft rubber eye of the catheter presses itself firmly into the lumen of the bronchus, thus closing it and preventing reflux of the contrast medium. Selective demonstration of the bronchial system of any apical segment is thus possible.

Six roentgenograms; 1 photograph.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Roentgen Appearances of the Lungs in 1,000 Apparently Normal Full Term Newborn Infants. Jerome Nadelhaft and Kent Ellis. Am. J. Roentgenol. **78:** 440–443, September 1957. (622 W. 168th St., New York 32, N. Y.)

The authors studied 1,000 chest roentgenograms of normal newborn infants meeting the following criteria: (1) minimum birth weight 2,500 gm.; (2) asymptomatic, uncomplicated postnatal period; (3) absence of any clinically significant cardiorespiratory abnormality. The roentgenograms were made according to a specified technic, within the first four days of life. The appearances were classified according to the following scheme:

Class I. Radiolucent lung fields without prominent pulmonary markings or focal areas of increased density.

Class II. Generalized mild increase in pulmonary density or markings of fine, coarse, or mixed pattern.

Class III. Generalized moderate increase in pulmonary markings, or density, definitely outside the usual range.

Class IV. Generalized marked increase in pulmonary density or markings.

Class V. Local increased pulmonary density in a region smaller in area than one-half of one lung field.

Class VI. Local increased pulmonary density in a region or regions corresponding in area to more than one-half but less than one whole lung field.

Class VII. Local increased pulmonary density in region larger than one lung field.

The borderlines between adjacent classes were not sharp. Ninety per cent of the cases fell in Classes I and II; 1 to 2 per cent in Class III; 3 to 4 per cent in Class V, and less than 1 per cent in Class VI. There were no cases in Classes IV and VII.

Knowledge of these variations will enable the radiologist to evaluate in a more intelligent manner the densities noted on the chest roentgenograms of newborn infants. In 5 per cent of the cases reviewed, shadows of increased density occurred which could have been interpreted as evidence of significant lung disease.

Seven roentgenograms; 1 drawing; 1 table.

H. C. JONES, M.D.
Grand Rapids, Mich.

Roentgenographic Findings in Hyaline Membrane Disease in Infants Weighing 2,000 Grams and Over. Kent Ellis and Jerome Nadelhaft. Am. J. Roentgenol. **78:** 444–450, September 1957. (622 W. 168th St., New York 32, N. Y.)

The chest roentgenograms of 7 infants weighing 2,000 gm. or more, who suffered from respiratory distress and died within the first four days following birth, were reviewed by the authors. At autopsy these patients were found to have alveolar atelectasis and hyaline membranes in the lungs. On all of the chest roentgenograms a generalized granular pattern of increased pulmonary density and sharply defined bronchial air shadows extending peripherally into the lungs were noted. These findings reflect the major histologic changes characteristic of hyaline membrane disease, particularly the generalized alveolar atelectasis; they do not represent the membranes.

Chest roentgenograms from three control groups were available for comparison: (1) infants of comparable age and weight with other pulmonary diseases proved at necropsy; (2) clinically normal newborn infants (see preceding abstract); (3) infants who had recovered from respiratory distress syndromes. Among these controls there were only 3 cases with findings closely resembling those observed in hyaline membrane disease. These were from the third group and may have actually been nonlethal examples of the condition under discussion.

The authors state that generalized increased granular density of the lung fields combined with conspicuous bronchial shadows and a history of respiratory distress in the early days of life are characteristic of hyaline membrane disease.

Six roentgenograms.

H. C. JONES, M.D.
Grand Rapids, Mich.

Review of Cases of Nontuberculous Disease Originally Diagnosed Pulmonary Tuberculosis. Richard M. Burke and James A. Weir. Am. Rev. Tuberc. **75:** 921–937, June 1957. (R. M. B., State Department of Health, Oklahoma City, Okla.)

In a three-year period, 608 (17.8 per cent) of 3,422 patients admitted to the tuberculosis section of Fitzsimons Army Hospital (Denver) were found to have nontuberculous disease. The ten conditions most frequently encountered, in order of their incidence, were: pulmonary fibrosis, pneumonia, bronchiectasis, histoplasmosis, coccidioidomycosis, pleurisy, malignant neoplasm, sarcoidosis, granuloma of undetermined etiology, lung abscess. This group represented 401 patients. In 90 patients no pulmonary disease was found, and in 117 a number of miscellaneous conditions were diagnosed.

Pulmonary fibrosis was the most frequently observed nontuberculous disease in this group, accounting for 26 per cent of cases in the ten categories listed above. There are no symptoms or significant physical findings in these patients. The most important single factor leading to the diagnosis was the presence of unchanging densities in the roentgenogram.

From their studies the authors are led to the following conclusions:

All previous chest roentgenograms in a case should be immediately reviewed. Evidence of a stable lesion, as determined by serial films, was the deciding factor in eliminating the possibility of active tuberculosis in at least 30 per cent of the patients in this series.

A single postero-anterior film is not sufficient. This should be supplemented by apical, oblique, and lateral views. Laminagraphy is invaluable.

At least three skin tests should be applied—tuberculin, histoplasmin, and coccidioidin—and a minimum of three sputum specimens or gastric aspirates for culture should be obtained. The great importance of tuberculin testing and sputum culture is emphasized.

Prompt biopsy is indicated in obscure lung lesions.

Thirteen roentgenograms; 4 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Failures in Photofluorography. H. Reber. Schweiz. med. Wchnschr. **87:** 1081–1085, Aug. 24, 1957. (In German)

The author reports the failure of photofluorography in 34 of 82 cases of tuberculosis in a school for Army recruits in the year 1951. The infiltrate was missed by the examiner in 15 cases, the findings were incorrectly interpreted in 18 cases; in 1 case the quality of the photofluorogram was at fault. These cases were later diagnosed by either tuberculin tests, supplemented by 14 × 17-inch roentgenograms, or by follow-up studies at the conclusion of military service.

Nine roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

A Roentgen Study of the Evolution of Carcinoma of the Lung. Leo G. Rigler. J. Thoracic Surg. **34:** 283–297, September 1957. (4833 Fountain Ave., Los Angeles 29, Calif.)

Due to the frequency with which routine chest examinations are performed, the author has been able to collect a group of cases allowing retrospective study following histologic proof of lung neoplasm. Of films obtained in some 100 such cases three months or longer prior to diagnosis, all but 2 showed evidence of an abnormality in the area of the lung later proved to be the site of the carcinoma.

It is recognized that retrospection often makes visible and significant shadows which might otherwise be overlooked. While not entirely indicative of the practical possibilities of roentgen diagnosis, such observations are nevertheless valid indications of the progress of the disease. Fortuitously, certain of these lesions were present for a considerable period of time on multiple studies without institution of any therapeutic measures either because the abnormality was not observed or was improperly interpreted, or because treatment was refused. Such serial study gives a vivid picture of the inception, development, and natural history of lung carcinoma.

The following points derived from this study are emphasized:

(1) More than 50 per cent of the cases exhibited roentgen evidence of the disease process more than two years prior to either the appearance of symptoms or the determination of a definite diagnosis.

(2) Numerous cases were observed in which the lesion arose as a peripheral process, extending centrally, with late invasion of a major bronchus.

(3) During the peripheral stage there may be a complete absence of symptoms. These will appear shortly after the lesion has extended centrally sufficiently to obstruct or otherwise involve a larger bronchus.

(4) In occasional cases the roentgen evidences of bronchial obstruction may be observed before the onset of symptoms.

(5) Obstructive emphysema of a whole lobe or even of a whole lung may occur concomitantly with segmental atelectasis.

(6) Cavitation may occur very early in the course of peripheral or central lesions and may disappear as the tumor grows.

(7) Inflammatory manifestations may appear and disappear during the life of the tumor.

(8) There appear to be marked differences in the rapidity of growth of the tumor at various times, but such observations may be more apparent than real.

(9) It is possible to reconstruct the anatomic situation and the development of a tumor of a bronchus when serial films in untreated patients are available and the roentgen technic is sufficiently good so that changes in the radiability of the various lung segments are visible.

The author concludes that it is important that we revise our ideas about the origin and the rapidity of growth of lung carcinoma, as evidence indicates that the majority of all cases arise in a branch bronchus rather than a major bronchus, and that in most cases growth is relatively slow.

Six illustrative case reports are included.

Fourteen roentgenograms; 14 drawings.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Roentgenologic Diagnosis of Peripheral Lung Cancer. S. Ia. Marmorshtein. Vopr. onkol. (Leningrad) 2 (No 5): 562–573, 1956. (Herzen State Oncological Institute, Moscow, U.S.S.R.) (From Abst. of Soviet Med. Part B **1:** 603, 1957)

The radiological picture in 278 patients with round shadows in the lungs was investigated. In 165 of these cases a peripheral cancer was demonstrated, and in 41 cases a benign lesion. The diagnosis of cancer was confirmed in 31 cases at operation and in the rest by the presence of distant metastases, by invasion of the chest wall, and finally by follow-up observations on patients who had refused operative treatment.

On radiologic investigation, special attention was paid to the changes in the pulmonary outline and in the pleura about the pathological round shadow. In contrast to the data given in the literature concerning the absence of any connection between the shadow of the peripheral cancer and the hilar shadow, the presence of a track leading from the tumor shadow to the hilus was established in 122 cases (73.9 per cent). In 52 cases the tumor shadows were joined to the hilar shadow by means of a nonhomogeneous track, consisting of separate wide shadows, in the main vascular with dense walls as confirmed by the fact that there was no diminution in their diameter on raising the intra-alveolar pressure. Histologic investigations of the lungs removed at operation showed in these cases the presence of perivascular sclerosis and hyalinosis, as well as peribronchial and perivascular infiltration by the tumor elements. In 70 cases the tumor shadow was joined to the hilus of the lung by a wide homogeneous track, giving the appearance of a continuation of the tumor shadow. Correlation of the x-ray picture with the pathological investigation of the operatively removed lung showed that the track in these instances represented a chain of enlarged metastatic lymph nodes, or was the result of growth of the tumor as far as the hilus.

In 42 cases the tumor shadow had no connection with the hilus.

Another important sign of peripheral cancer was the appearance, in 88 patients (53.3 per cent), of a more or less distinct pleural stratification at the level of the tumor, as a result of the spread of the cancerous process, evidently by the superficial subpleural lymphatic network of the lung.

FALILEEV
Moscow

Bronchial Adenoma. A Study of 60 Patients with Resections. Richard H. Overholt, James A. Bougas, and Dryden P. Morse. Am. Rev. Tuberc. **75:** 865–884, June 1957. (R. H. O., 135 Francis St., Boston 15, Mass.)

This report is based on a study of 60 patients with resection of bronchial adenoma observed over a period of twenty-three years. In contrast to patients with other pulmonary tumors the cure rate is very high. The disease is found in a younger age group than bronchogenic carcinoma and is more common in females. The average age in this study was forty years.

The clinical pattern of dry cough, unilateral wheeze, and hemoptysis is suggestive of this tumor. Late symptoms are secondary to obstruction resulting in atelectasis and infection; they consist of cough, which is often productive, chills, fever, and occasionally weight loss. The course of the disease may be very long (twenty years or more); the average duration of symptoms in the present series was over three years. The duration of symptoms did not appear to be related to curability or resectability.

The most common roentgenographic changes were those indicating atelectasis and inflammatory disease. Twenty of the patients exhibited atelectasis and 19 had signs of pulmonary inflammation. Other findings were: a hilar mass in 3 cases, lobar emphysema in 2, pleural effusion in 2, and cyst formations in 2. These observations were helpful, along with bronchography and tomography, in suggesting the diagnosis. The diagnosis was made by bronchoscopy in less than one-half of the patients. Biopsy was not used routinely because of the risk of hemorrhage.

A large majority of the lesions were central in location and in the lower lobes. Thirty-five of the tumors were on the right side. Cytologic study of bronchial washings was of no value in the present group; in none of 10 cases was evidence of tumor obtained.

Five of the patients died with distant metastases, while 4 others were found to have lymph node metastasis at surgery. Two of the latter group are alive more than ten years after operation. In two-thirds of the patients the bronchial wall was invaded; and 2 others had direct extension of the tumor to adjacent lymph nodes and 6 had node metastases. This means that endobronchial removal of the tumor is not a safe procedure.

The results of surgical treatment were good. Forty-eight of the patients were living and well at the time of the report; 5 had died of metastases, 4 of intercurrent disease, and 3 patients died in the immediate postoperative period. It is therefore apparent that the surgical excision of bronchial adenoma results in a high rate of cure in contrast to other lung tumors with malignant potential.

Six figures, including 3 roentgenograms; 11 tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Roentgen Manifestations of Erythema Exudativum Multiforme (Stevens-Johnson Syndrome). Harrison Shapiro and Robert M. Lowman. Dis. of Chest **32:** 329–334, September 1957. (R. M. L., Yale University School of Medicine, New Haven, Conn.)

Erythema exudativum multiforme is an acute mild exanthematous disease of little apparent consequence, with mucocutaneous involvement in varying degrees from maculopapular to vesiculo-bullous dermatitis. While no single etiologic agent has been isolated, it is suspected that the disease is an allergic or hypersensitivity reaction to various pharmacological and bacteriological excitants. The prognosis is good and the course is usually self-limited, with complete regression of pathological changes.

The chief roentgen manifestations are in the lung, where pneumonitis frequently occurs, which is indistinguishable clinically, radiologically, and often serologically from primary atypical pneumonia of unknown etiology. This is probably secondary to mucosal changes in the tracheobronchial tree, which may vary in location, intensity, and time of onset as do the manifestations in other portions of the mucocutaneous system. In mild cases the pneumonitis may be manifested only by localized prominence of the bronchovascular markings; in some of the fatal cases almost complete consolidation of both lungs has been noted.

The authors present two illustrative cases, both in patients with strong allergic backgrounds.

Three roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

A Case of Chicken-Pox Pneumonia with X-Ray Findings Suggesting Metastatic Carcinoma. Herbert G. Levin. New England J. Med. **257:** 461–462, Sept. 5, 1957. (17300 Schaefer, Detroit 35, Mich.)

Complications of varicella may occasionally be serious, especially in adults. A 28-year-old woman entered the hospital because of a girdle type of chest pain and cough developing one week after chickenpox with a typical skin eruption. A chest film made on admission demonstrated multiple nodular densities scattered throughout both lung fields, measuring up to 15 mm. in diameter. These were interpreted as metastatic neoplasm. An intensive search was made for a primary tumor, but no important abnormalities were demonstrated other than a mild nonspecific anemia and a moderately elevated erythrocyte sedimentation rate. For two weeks the patient ran a low-grade fever associated with slight increase in size of the multiple lung nodules, with some tendency toward coalescence. After approximately three weeks several of the lesions showed central cavitation. Planigrams demonstrated central areas of rarefaction in many of the lesions, but it could not be determined whether these represented destructive foci or beginning re-aeration. Serial filmings showed gradual resolution, with return of an essentially normal appearance of the chest some three months later.

The point is made that lung complications may not occur for one or two weeks after the skin eruption of varicella. These pulmonary findings may be indistinguishable on initial appearance from metastatic lung disease.

Three roentgenograms.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Contribution to Roentgen Diagnosis and Classification of Pulmonary Paragonimiasis. F. Géher. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 313–321, September 1957. (In German) (Üllöi u. 78/B, Budapest VIII, Hungary)

Paragonimiasis, known also as pulmonary distomiasis and endemic hemoptysis, occurs mainly in the Far East, particularly in Korea and Japan. The author, who worked in a hospital in Korea, has surveyed some 8,000 workers in mines and iron works and has found that paragonimiasis occurs there almost as frequently as tuberculosis.

The disease is caused by a trematode and is acquired by eating uncooked freshwater crabs or crayfish. The larvae penetrate the intestinal wall and the peritoneum, then bore their way through the diaphragm into the lungs. There may also be a generalized dissemination, with involvement of other organs, mainly the brain.

The clinical symptoms resemble those of tuberculosis—a dry cough and dyspnea, often with a brownish-reddish, bloody sputum. The diagnosis is based upon the discovery of ova in the sputum and upon the x-ray findings. The author divides the latter into four stages: The first is the infiltrative period, characterized by exudation and infiltrations just above the diaphragm. These sometimes lie behind the heart and are often hard to demonstrate. The second stage is the period of nodular or cystic densities, measuring from 8 to 37 mm. in diameter. The nodules or cysts, which occur in the lower and middle lung fields, contain the worm embedded in fibrous tissue. This is roentgenologically the most characteristic stage. Gradually the small bronchi produce vacuolization in the nodules, giving them the appearance of cavities. At this time the sputum examination often reveals the ova. Pleuritic exudates occur in about 10 per cent of the cases. Possible complications are atelectasis, pneumonia, pneumothorax, and lung abscess. The nodules may also occur in the infraclavicular area or be disseminated fairly equally over both lungs. This stage may last from a few months to several years.

In the third stage, with death of the parasite, a fibrosis sets in and the vacuoles disappear. The x-ray film now shows homogeneous densities measuring from 7 to 8 mm. in diameter, from which cords may radiate into the surrounding lung tissue. In the fourth stage there is a gradual resorption of the densities and deposition of calcium, leaving calcifications of from 2 to 5 mm. in diameter, closely resembling tuberculosis.

The author's experience includes 253 autopsies, in which the disease could be definitely diagnosed in 81 instances.

Eight roentgenograms; 1 table.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Aspergillosis of the Lung. L. B. Godfrey. Irish J. M. Sc., pp. 407–411, September 1957. (Dublin Regional Chest Hospital, Blanchardstown, Ireland)

Aspergillus is not infrequently found in certain lung diseases and in debilitated patients as a harmless pathogen, but evidence is increasing that it may be a cause of primary infection, manifested by bronchitis, pneumonia, lung abscess, or asthmatic symptoms due to sensitization to the fungus. In this last condition, the bronchi may be plugged by aggregates of mycelia, mucus, fibrin, eosinophilic cells, and Charcot-Leyden crystals, leading to collapse or consolidation of migratory character. X-ray findings and symptoms in these forms are not pathognomonic.

The author reports 3 cases presenting a particular clinical picture, namely, a localized tumor or mycetoma. All were undiagnosed or treated as tuberculosis for several years. The characteristic x-ray appearance is that of a well defined mass, surrounded by a thin layer of air. If this surrounding radiolucency is absent, differentiation from cyst or neoplasm is not possible.

Treatment is surgical.

Three roentgenograms.

J. S. ARAJ, M.D.
Toledo, Ohio

Aortic-Body Tumor (Chemodectoma) of the Mediastinum. Report of a Case and Review of the Literature. Harvey Mendelow and Morris Slobodkin. Cancer **10:** 1008–1014, September-October 1957. (H. M., Mt. Sinai Hospital, New York 29, N. Y.)

A case of aortic-body tumor, or chemodectoma, of the mediastinum, is reported, and 6 previously recorded cases are reviewed, with particular attention to the clinical behavior and pathological features.

Aortic-body tumors clinically and pathologically closely resemble the well known tumor originating in the neck from the carotid body and the less familiar chemodectomas occurring at other sites. They apparently arise from one of several known chemoreceptor bodies located along the course of the aortic arch in the thoracic cavity. Two cases, however, have been found in the posterior mediastinum, where chemoreceptor bodies have not as yet been anatomically identified.

From the clinical standpoint, the aortic-body tumor is a remarkably silent one, 3 of the cases having been discovered on routine roentgenography and 2 incidentally at autopsy. The remaining 2 became clinically apparent as masses in the neck causing pain and other symptoms referable to the displacement of local structures; on further investigation, these were found to extend upward from the mediastinum, behind the clavicle.

The authors' patient was a 31-year-old white woman, in whom a pre-employment chest roentgenogram disclosed a mass in the right mediastinum. Review of symptoms revealed only an occasional sensation of heaviness or oppression in the sternal area when the patient was in bed. This had been noted for a few months. Multiple roentgenograms of the chest showed a lobulated right hilar and superior mediastinal density extending into the upper anterior mediastinum. The upper segments of the trachea and esophagus were displaced posteriorly and to the left and were apparently compressed between the anterior mediastinal mass and the aortic arch. Laminagraphy confirmed the location of the mass as mainly anterior and did not demonstrate any calcification. Roentgenograms of the hands and feet revealed nothing of significance.

Exploratory thoracotomy disclosed a nodular mass, 12 × 8 × 5 cm., in the anterior superior mediastinum. This was rubbery in consistency, highly vascular and friable, and pink. A specimen was taken for biopsy, but the profuse bleeding attendant upon even this procedure and the dense adhesions to the superior vena cava precluded any more definitive surgery.

Seven days after surgery, deep roentgen therapy to the area of the tumor was begun. Sixteen treatments were given over a three-week period, for a total of 2,400 r (skin dose) over each field. No changes in the patient's condition or in the roentgenographic appearance of the

mass were observed during a follow-up of several months.

The recommended treatment for chemodectoma varies with location and type and depends on the features of close adherence to large arteries and local invasiveness. The tumor is evidently resistant to radiotherapy, as demonstrated in at least 2 cases. Attempts at surgical removal are fraught with hazard, owing to extreme vascularity. The chemodectoma, however, is characterized by a slow indolent course and clinically silent behavior not at all incompatible with long life.

One roentgenogram; 4 photomicrographs; 1 table.

THE HEART AND BLOOD VESSELS

Abnormalities Seen on Chest Photofluorograms and Diagnosable Heart Disease. Armand E. Brodeur, James P. Baker, and Philip E. Enterline. Am. J. Roentgenol. **78:** 226–233, August 1957. (A. E. B., 141 Horseshoe Drive, Kirkwood 22, Mo.)

The authors present the results of a survey to determine the proportion of heart disease which photofluorographic chest surveys are capable of detecting. The material used was from the Greenbrier Clinic in White Sulphur Springs, West Virginia, where periodic physical examinations are made. As far as could be determined, this group seemed to be generally representative of other working groups as regards cardiac disease.

In routine surveys for pulmonary tuberculosis reported by others, cardiovascular abnormalities have been noted in an average of 0.5 per cent of the films and, where follow-up has been done, these have produced between one and two confirmed cases of heart disease per thousand examinations, of which 60 to 80 per cent were previously known. The percentage of positive cardiovascular findings increases when the films are read specifically with this possibility in mind.

In the present study 2,174 persons were examined; for each, postero-anterior and lateral chest films as well as an electrocardiogram were obtained. Two hundred and eighteen were found to have heart disease or possible heart disease. Most of these patients were business executives. All films were read by one person without knowledge of the diagnosis established and without any records except a copy of the 70-mm. film. The addition of a lateral view of the chest did not improve the ability of the film reader in sorting out heart disease.

Cases with false positive readings were diagnosed as heart disease on subsequent examinations more frequently than were true negatives. It is concluded that, with proper reading criteria, chest photofluorography compares favorably with other screening devices for heart disease.

Five tables.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Roentgenologic Follow-Up on 150 Consecutive Mitral Commissurotomy Patients. John G. McAfee and Paolo Biondetti. Am. J. Roentgenol. **78:** 213–223, August 1957. (J. G. M., Department of Radiology, Johns Hopkins Hospital, Baltimore, Md.)

The authors report their findings in a series of 150 consecutive mitral commissurotomies, for 115 of which roentgenologic follow-up studies were made from two weeks to a maximum of five years postoperatively. These patients were operated upon by Dr. Alfred Blalock and his staff at the Johns Hopkins Hospital between November 1949 and June 1954.

The postoperative changes in heart size were evaluated by (1) simple inspection and superimposition of the posterior anterior chest roentgenograms; (2) measurement of the cardiothoracic ratio; (3) measurement of the net frontal plane by the method of Hodges and Schwarz. No single method of estimating heart size was found completely satisfactory.

In the first three months following surgery, a transient increase in the cardiac silhouette occurred in almost half the cases. A permanent increase or immediate decrease was unusual. About 25 per cent of the group showed a decrease in size and 20 per cent a persistent increase. A true assessment of the effects of surgery would be possible only if a similar group of patients without surgery could be followed. In 8 of the 150 patients a reactivation of the rheumatic process developed, with an increase in heart size postoperatively.

Roentgenologically, only 60 per cent of mitral valvular calcifications were detected. A relatively large percentage of minimal calcifications of the valve cusps were missed fluoroscopically. The incidence of mitral calcification in the patients with mitral insufficiency was higher (43 per cent) than in those with pure stenosis (10 per cent), as has been reported by others.

The inability to differentiate mitral stenosis from insufficiency or to evaluate the relative importance of the two lesions when both are present has remained an unsolved problem of cardiac roentgenology. In patients with combined stenosis and insufficiency, surgical exploration is sometimes the only means of determining their relative functional significance.

Eleven roentgenograms; 5 tables.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

The Size of the Pulmonary Artery in Rheumatic Heart Disease with Isolated Mitral Stenosis and Its Significance. Louis A. Soloff, Jacob Zatuchni, George E. Mark, Jr., and Herbert M. Stauffer. Am. J. M. Sc. **234:** 313–320, September 1957. (Temple University School of Medicine and Hospital. Philadelphia, Penna.)

Measurement of the diameter of the pulmonary artery on conventional roentgenograms is not possible because of overlapping anatomic structures. This study was performed in an effort to define the pulmonary artery shadow and, if possible, to relate its size to intra-arterial pressure, aortic size, left atrial size, total heart size, and age. The combined technics of cardiac catheterization and sequential biplane stereoscopic angiography were carried out on 25 patients with rheumatic heart disease and isolated mitral stenosis.

The characteristic roentgen picture in this condition shows a small aortic knob, prominent pulmonary artery segment, and enlargement of the left atrium. The small aortic knob has led to the belief that the aorta is hypoplastic. Findings in this study indicate that this is not the case, and that aortic size is normal.

Similarly, the measurements made by the authors evidently refute the belief that a large pulmonary artery is the principal cause of enlargement of the pulmonary artery segment. In 25 per cent of the examinations the pulmonary artery diameter was within normal limits. It appears rather that the pulmonary artery at its origin may be displaced toward the left by the enlarged left atrium and also by an enlarged right atrium and ventricle, if present. The pulmonary artery then courses obliquely rather than following its normal sagittal course, and is thus projected so that it tends to form the

lower portion of the enlarged pulmonary artery segment.

No correlation appeared to exist between pulmonary artery size and age, nor between its diameter and the volume of the left auricle or total heart size.

There did seem to be a linear relationship between pulmonary artery diameter and the presence of pulmonary hypertension. However, the degree of pressure elevation could not be predicted from measurements of the artery. The findings furthermore seemed to indicate that pulmonary artery pressure is overshadowed by other factors in production of whatever left atrial enlargement may exist.

One figure; 2 tables. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Intravenous Carbon Dioxide for Intracardiac Gas Contrast in the Roentgen Diagnosis of Pericardial Effusion and Thickening. Robert E. Paul, Thomas M. Durant, Morton J. Oppenheimer, and Herbert M. Stauffer. Am. J. Roentgenol. **78:** 224–225, August 1957. (H. M. S., Temple University Hospital, 3401 N. Broad St., Philadelphia 40, Penna.)

The authors describe a technic of administering carbon dioxide intravenously for intracardiac gas contrast. Earlier experiments demonstrated the safety of the procedure in dogs (see Stauffer *et al.*, Radiology **66:** 686, 1956). In the present paper the authors state that there has been no untoward reaction following the rapid injection of 50 to 100 c.c. of carbon dioxide in man, though the number of cases thus studied is not stated.

A syringe with a three-way stopcock is flushed with saline to eliminate any air leak and a contenuous intravenous drip is arranged in the antecubital vein. One hundred per cent carbon dioxide is introduced through the intravenous tubing.

Two illustrations demonstrate pericardial effusion in a myxedematous patient and a thickened pericardium in calcifying constricted pericarditis.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Portal Circulation in Constrictive Pericarditis. A Study of the Spleen-Lung Ether Time in Relation to Splenoportography Before and After Pericardiectomy. Vicente Gilsanz, Agustín Vergara, and Luis Estella. Arch. Int. Med. **100:** 201–208, August 1957. (V. G., Diego de Leon 34, Madrid, Spain)

The authors have made a comparison of the circulation time in the portal region and the general circulation in normal individuals and in patients with cardiac insufficiency associated with marked congestion of the liver, in patients with pericarditis with effusion, and in patients with constrictive pericarditis. One cubic centimeter of ether, mixed in a syringe with 3 c.c. of isotonic saline, was injected transparietally into the spleen, after which the spleen-lung time was determined. This was compared with the arm-lung circulation time (also measured with ether). No untoward reactions occurred except in 1 patient in whom the injected material was localized in the splenic capsule. In 10 normal subjects the spleen-lung time was five to six seconds, *i.e.*, one-half to one second less than the arm-lung time. Immediately after the ether injection, splenoportography was carried out, using Umbradil or a similar contrast material (20 to 40 c.c. of a 70 per cent solution) introduced by a transparietal route. Serial roentgenograms were taken very rapidly, since under normal conditions the medium disappears from the portal area within three seconds.

In 2 patients with pericarditis with effusion and hepatomegaly, the spleen-lung ether time was normal, and the splenoportograms showed no abnormality; the interval during which the contrast material remained in the portal system also coincided with that in normal individuals. In a patient with a pericardial effusion secondary to a neoplasm of the thymus, with multiple metastases, the spleen-lung and arm-lung times were both prolonged. In 4 patients with hepatic congestion, in most instances of several years duration, although there was a relative diminution in the vascular patterns of the portal area, the ramifications of the second and third order were demonstrable. The relative slowing of the portal circulation, when present, is analogous to that found in other regions. This is established by the fact that the spleen-lung time is always related to the arm-lung time and in general is related to the time the contrast medium persists in serial splenoportograms.

In 2 patients with constrictive pericarditis, the spleen-lung circulation time was found to be extraordinarily prolonged in relation to the arm-lung time. This is considered indicative of an obstruction, specifically in the portal circulation. Splenoportography revealed a great diminution in intrahepatic arborization. After pericardiectomy, the spleen-lung time was five seconds in both of the patients, and the intrahepatic arborization pattern was normal.

In some patients there was a discrepancy between the spleen-lung time and the persistence of the contrast material, as seen in the splenoportogram. The authors believe that in such cases, after the injection is completed, there is an autopropulsion of the contrast material, which is deposited in the spleen. This occurs particularly when in the splenoportographic silhouette the medium appears below the splenic capsule.

Measurement of the spleen-lung ether time is considered a better method for determining the circulation time than serial portography. The authors conclude that the pathogenesis of the slowing of the circulation is not the same in hepatic congestion as in constrictive pericarditis. In the first there is a relation between the slowing of the portal circulation and the slowing in other venous areas. In the second, obviously there must be an obstacle, which is interpreted as a sequel to the profuse fibrinous reaction over the surface of the liver. This obstacle is reversible after operation. In any event, it is not possible to identify the splenoportographic images or the alterations of the circulation time in the region of the portal vein in cases of hepatic congestion and constrictive pericarditis.

Six roentgenograms; 4 drawings.

Roentgen Diagnosis of Aortic Coarctation in an Unusual So-Called Lower or Atypical Region, by Retrograde Aortography; Report of Two Cases, One Treated by Surgery. Raul Pereiras, P. Iglesias Betancourt, Ramón Aixala, J. V. Muñiz Sotolongo, A. Gómez Hernández, A. Castellanos González, G. A. Sánchez Hernández, Enrique Hechevarría, and Rolando Pereiras. Radiología, Panama **7:** 132–137, September 1957. (In Spanish) (Hospital Universitario Calixto García, Havana, Cuba)

This article includes a review of the literature on coarctation in the distal aorta and reports of 2 cases diagnosed by retrograde aortography.

The finding of aortic coarctation beyond the level of the ductus arteriosus is somewhat unusual. A review of the reported cases shows that it occurs with about the same frequency above and below the diaphragm. The diagnosis is suggested by hypertension in the upper extremities with relative diminution of pressure and vascular pulsations in the lower extremities. A systolic murmur may be heard on auscultation along the thoracic spine. Electrocardiograms and ballistocardiograms provide no direct diagnostic help. On the chest film the aortic shadow appears normal. In one of the authors' cases selective notching of the ninth ribs was demonstrated, with sparing of the other ribs.

Localization of the lesion is important in order to show where the surgical approach should be made; retrograde aortography is especially useful for this purpose. In one of the reported cases so studied it was possible to resect the constricted area and to make an end-to-end anastomosis without the use of an insert or graft.

The authors have sometimes used angiocardiography, though the procedure may be difficult and may have to be repeated. In addition, the findings are more likely to be misinterpreted. By injection of a contrast medium through a catheter placed in the right heart, it has been possible to obtain useful information about circulatory velocity, right heart size, etc.

Four roentgenograms. DON E. MATTHIESEN, M.D.
Phoenix, Ariz.

Aneurysmal Dilatation of the Aortic Sinuses in Marfan's Syndrome: Angiocardiographic and Cardiac Catheterization Studies in Identical Twins. Israel Steinberg, Joseph L. Mangiardi, and William J. Noble. Circulation **16:** 368–373, September 1957. (St. Francis Hospital and Sanatorium, Roslyn, N. Y.)

Two cases of aneurysmal dilatation of the aortic sinuses in association with Marfan's syndrome are reported, being the sixth and seventh recorded examples in this syndrome to be diagnosed by angiocardiography. The patients were identical twins, two years of age, and the cardiac studies were undertaken in the course of an investigation of the causes of heart enlargement and murmurs discovered on routine examination for a respiratory ailment. Other features of Marfan's syndrome were not marked but, once looked for, were recognized—dolichocephaly, arachnodactyly, and slight arching of the palate. Ophthalmoscopic examination completed the diagnosis by disclosing the characteristic dislocation of the lenses.

Right heart catheterization studies in both twins were normal, but in one a patent foramen ovale permitted left atrial and ventricular pressure determinations. These revealed absence of a left atrial systolic pressure peak, a normal mean pressure, and a narrow atrial pulse pressure, which ruled out significant mitral insufficiency. Aortic valvular stenosis was also excluded by the left ventricular pressure reading.

The authors suggest that left ventricular enlargement, found in both of their patients, may be due to endocardial degeneration. Since the aneurysms were present at so early an age, it is further concluded that medial degeneration of the aortic sinuses occurs early and does not develop in response to aortic stress.

Six roentgenograms; 1 electrocardiogram and pressure tracing; 1 table. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Hypoplasia of the Lobar Pulmonary Arteries. A Report of Three Cases. J. R. Belcher and J. N. Pattinson. J. Thoracic Surg. **34:** 357–364, September 1957. (London Chest Hospital, London, England)

The authors report 3 cases of hypoplasia of lobar pulmonary arteries, all believed to be congenital in origin, occurring as isolated anomalies. In each case the affected lobe showed increased radiolucency but occupied less space than normal.

The essential cause of increase in radiolucency is diminution in the size and number of vascular markings. When this occurs as a result of a "check-valve" obstruction or emphysema, the area concerned becomes distended, occupying more space than normal. Pulmonary embolism without infarction can produce increased radiolucency in a lobe of normal size. In bronchiectasis with atelectasis, reduction in lung size and diminution of blood flow may occur, but the loss of vessel caliber is less pronounced than in lobar artery hypoplasia. In the authors' 3 cases, angiography demonstrated the caliber of the lobar artery to be only 30 per cent of normal.

Bronchial abnormalities were noted in all 3 patients; in 1 there was gross bronchiectasis, in another the bronchi were abnormal in distribution and showed buds along their course, and in the third there was a minor degree of bronchial dilatation. In the first 2 cases the added infection was considered secondary, developing in the congenitally abnormal lobe. The authors suggest that the existing confusion of cause and effect between diminished pulmonary vascularity and bronchiectasis may well be responsible for the fact that the entity presented has not previously been described.

Hypoplasia of a lobar artery has been reported in association with intralobar sequestration. In the 2 operated cases a search was made for anomalous arteries but none were found.

The authors conclude that no one investigation is sufficient to establish the diagnosis. The finding of an emphysematous, though small, lobe is not diagnostic, as this combination may be seen in simple bronchiectasis. Where, however, little or no bronchial dilatation is present in an emphysematous lobe which is smaller than normal and, more especially, where bronchospirometry shows diminished oxygen uptake despite normal ventilation, than angiography, by demonstrating great diminution in the size of a lobar artery, can confirm the diagnosis in a way not possible with any other preoperative procedure.

Eight roentgenograms; 2 photographs.
CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Femoral Arteriography; A Simple and Safe Method. Donald C. Nabseth and Max Ritvo. New England J. Med. **257:** 502–504, Sept. 12, 1957. (M. R., Harvard Medical School, Boston, Mass.)

In general, femoral arteriography should be undertaken when the information to be obtained is expected to provide a practical approach to the further management of a vascular problem. The patient is placed in a supine position on the radiography table and a special lead shield is suspended vertically above him across the table. After puncture of the artery has been effected, but before the contrast material is injected, the adjustable shield is lowered to a position approximately against the symphysis pubis. At subsequent exposure

of the films, the operating personnel and the upper half of the patient's body are effectively screened from the roentgen rays.

Thigh and leg are radiographed simultaneously with the following factors: target-film distance about 57 inches, 60 to 70-kv, 50 ma, 2 seconds. Two 14 × 17-inch films are used; one in the Bucky tray with its upper margin at the upper end of the thigh; and the second on the table top beneath the leg with a stationary grid and so placed to overlap slightly the lower edge of the thigh film. The authors recommend arterial puncture with a long, thin, 18-gauge needle attached directly to a 30- or 50-ml. Luer-Lok syringe filled with 30 c.c. of 35 per cent Diodrast. Immediately before injection of the medium an assistant must firmly compress the iliac artery of the side to be examined. The contrast material is injected relatively slowly, over a 6 to 10 second interval, and the single exposure is made at approximately the end of the injection. This, the authors believe, is an important point in demonstrating vascular lumens distal to the site of obstruction by allowing sufficient time for the contrast material to traverse the collaterals. Occasionally it will be necessary to inject part of the medium, wait a few seconds, and then complete the injection in order to allow filling of vessels distal to an obstruction. The needle may be left in the artery for use at a second injection should the first prove unsatisfactory. Ordinarily the examination is performed with the patient under general anesthesia.

No important complications have been encountered with this procedure. Extravasation of the medium has not been serious. Great caution should be used in performance of arteriography on a vessel which has undergone prolonged, markedly decreased intraluminal pressure because of the possibility of severe subsequent arteriospasm.

The authors emphasize the importance of effective compression of the iliac artery at the time of contrast material injection to allow a good visualization of the distal arteries resulting from a slower rate of dilution of contrast material by the blood stream.

One photograph. JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Subcutaneous Rupture of a Popliteal Aneurysm, with a Diagnostic Roentgen Sign. Jacob J. Silverman and Elliott S. Hurwitt. Arch. Int. Med. **100:** 314–318, August 1957. (E. S. H., Montefiore Hospital, New York 67, N. Y.)

A case of spontaneous rupture of a popliteal aneurysm, characterized by hematomatous dissection in the subcutaneous tissue, is reported. Extensive bluish discoloration of the skin with swelling led initially to an erroneous diagnosis of phlegmasia cerulea dolens. The correct diagnosis was finally established one month after the rupture, just prior to successful surgical excision. During this time viability of the foot of the involved extremity was satisfactory.

In a plain roentgenogram of the thigh a sign pathognomonic of a ruptured popliteal artery was observed, which the authors could not find described in the literature. This consists of a "blowout" in the course of a calcified femoral artery characterized by a dispersion of the calcium at the site of interruption. The authors recommend that roentgenograms of the lower thigh be taken routinely whenever a popliteal aneurysm is suspected.

Three roentgenograms; 3 drawings.

Pulseless Disease Due to Branchial Arteritis. Bohdan J. Koszewski and Theodore F. Hubbard. Circulation **16:** 406–410, September 1957. (B. J. K., Creighton University School of Medicine, Omaha, Nebr.)

A case of pulseless or Takayasu's disease is described in a 13-year-old Negro girl. Radial, brachial, and temporal arteries were not palpable. Carotid pulsation was absent on the left and slight on the right. Femoral, popliteal, and pedal pulses were strong and symmetrical. Arteriography revealed an apparent occlusion in the right subclavian at its junction with the axillary artery. The thyrocervical trunk and innominate were normal, but none of the contrast medium entered the internal carotid. Pulsation and blood pressure were normal in the abdominal aorta and the legs.

Tissue obtained on exploration of the right common carotid showed inflammatory infiltration of all coats of the vessel with polymorphonuclears and a few monocytes and leukocytes.

Vigorous therapy with steroids and anticoagulants for two years resulted in some apparent improvement.

The point is made that the histologic picture is distinct from that in other forms of arteritis and that the changes are confined to the area of the original branchial arteries—hence the authors' designation "branchial arteritis."

One roentgenogram; 1 photomicrograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Inflation of Esophageal Hernial Sac in the Course of Induced Pneumoperitoneum. John M. Workman. Am. Rev. Tuberc. **75:** 823–827, May 1957. (Western North Carolina Sanatorium, Black Mountain, N. C.)

The author reports a case of a rare complication of therapeutic pneumoperitoneum. Only one previous instance of air-filled peritoneal protrusion into the thorax through the esophageal hiatus could be found in the literature (Friedman, R. L.: J.A.M.A. **150:** 211, 1952).

In a 66-year-old white female with bilateral far advanced pulmonary tuberculosis pneumoperitoneum was induced eight months after initiation of chemotherapy. The hernia was demonstrated on chest roentgenograms taken two months later. A radiolucent area was seen behind the heart and was believed to represent a hiatus hernia. An esophagram showed an air-filled hernial sac surrounding the herniated part of the gastric fundus. Because of danger of rupture of the sac, resulting in pneumothorax and/or pneumomediastinum, this complication is believed to be an indication for abandoning pneumoperitoneum.

Three roentgenograms; 1 drawing.

JOHN H. JUHL, M.D.
University of Wisconsin

Coexistent Achalasia of the Esophagus and Hiatal Hernia of the Cardiac End of the Stomach. Edwin J. Euphrat and J. Ernest Delmonico, Jr. J. Thoracic Surg. **34:** 395–398, September 1957. (E. J. E., Onondaga General Hospital, Syracuse, N. Y.)

Achalasia and hiatal hernia are distinct entities and individually not uncommon. Their coexistence, however, is rare, being estimated at 1 in 200,000.

The authors present a case occurring in a 47-year-old female. The demonstration of what appeared to be a

fairly large hiatus hernia in addition to marked dilatation of the esophagus posed a problem in differential diagnosis. Four possibilities were considered. (1) The hiatal hernia might have produced obstruction and secondary stenosis at the cardia due to reflux esophagitis. (2) The hernia might have been an incidental occurrence in the presence of achalasia. (3) The hernia might have aggravated an obstruction due primarily to achalasia. (4) The findings attributed to hiatal hernia might have been produced by a pocket of air in a redundant distal segment of elongated dilated esophagus.

At surgery, a hypertrophied distal esophageal segment was found, as well as angulation at the cardia due to the hernia, which contributed to the obstruction. Certain authorities do not advise correction of the hernia when it coexists with achalasia. In instances such as this, where the hiatal hernia constitutes an additional obstruction factor, hernia repair as well as the Heller esophagomyotomy appears to be indicated.

One roentgenogram; 1 drawing.

CHARLES M. GREENWALD, M.D.
Iowa City, Iowa

Carman Sign of Ulcerating Gastric Carcinoma. Bernard S. Wolf and Charles J. Sherkow. Am. J. Digest. Dis. **2**: 467–477, September 1957. (Department of Radiology, Mount Sinai Hospital, New York 29, N. Y.)

The authors consider the Carman sign of ulcerating gastric carcinoma and attempt to clarify some of the confusion which exists in the medical literature concerning the nature of this finding.

The roentgen observations described by Russell D. Carman (Am. J. Roentgenol. **8**: 695, 1921) as indicative of a particular type of ulcerated gastric carcinoma have proved in the authors' experience to be extremely reliable. Unfortunately, descriptions of the "Carman sign," or the "meniscus sign," available in current texts are not faithful to the original description. Carman's chief contribution was to point out that malignant ulceration which did not project beyond the contour of the gastric lumen could be identified by careful palpatory pressure during fluoroscopy of the barium-filled stomach. The essential finding was a relatively shallow, elongated ulceration from 3 to 8 cm. in diameter which could be demonstrated as a persistent homogeneous patch or collection of barium when the bulk of the overlying barium was displaced from the region by the palpating fingers. This effect was said to be produced by approximation of the margins of the ulcerated tumor, thereby penning up the barium within the depressed center. The barium had a distinct tendency to collect in or adhere to the ulcerated center and to be retained within it.

Carman stated that when an ulcerated area of this kind was present on the vertical portion of the lesser curvature, or on the posterior wall near the lesser curvature, and the lesion was brought into profile, the persistent patch of barium might have a crescentic or "meniscus" appearance, convex away from the lumen. This specific configuration, however, he did not consider an essential feature of his description.

Kirklin later (Radiology **22**: 131, 1934; Am. J. Roentgenol. **47**: 571, 1942) amplified the roentgen observations of Carman and transferred the emphasis from the ulcerated center to the semicircular or arcuate lucent overhanging ridge of tumor tissue forming the periphery of the lesion. He suggested the term "meniscus complex" to include both the ulcerated center and the elevated border. Subsequent authors have made the error of referring to the lucent peripheral ridge as the "meniscus sign."

The observations of Carman and Kirklin were based on careful palpatory pressure applied during fluoroscopy. Current spot technics with graded compression permit excellent radiographic recording of the important features. An irregular nodular appearance of the peripheral ridge of tissue can often be demonstrated in this fashion.

The description of Carman was confined to lesions 3 cm. or more in diameter. Kirklin pointed out that the same features were applicable to smaller lesions. In such cases, however, errors may occur in differentiating a neoplastic ridge from the inflammatory collar of a benign ulcer.

Eight roentgenograms.

THEODORE E. KEATS, M.D.
University of Missouri

Correlation of Symptoms with Gastroscopic Findings, X-Ray Findings and Gastroscopic Biopsy in Gastritis. Leonard Atkins, Edward B. Benedict, and Jack R. Dreyfuss. Gastroenterology **33**: 385–388, September 1957. (Massachusetts General Hospital, Boston 14, Mass.)

This article reaffirms the difficulty of substantiating the clinical diagnosis of gastritis. The gastroscopic, radiographic, and histologic findings in 55 patients with suspected gastritis were correlated with clinical symptoms. Seventy-six per cent were abnormal gastroscopically, 58 per cent were abnormal radiographically, while only 29 per cent were abnormal microscopically.

The radiographic findings in acute gastritis and atrophic gastritis are entirely unreliable. In chronic gastritis, however, the radiographic findings are more constant. Hypersecretion and thickening of mucosal folds may be marked. It is emphasized that the radiologist sees only a reflection of the gross physiologic and anatomic derangement in the mucosa and muscularis mucosa, while the gastroscopist relies on his direct observation of the gastric mucosal surface. The poor correlation of histologic findings with symptoms and gastroscopic findings is accounted for by the difficulty in recognizing the histologic counterpart of gross reddening and edema.

One table.

ROBERT S. ORMOND, M.D.
Dearborn, Mich.

Examination of the Mucous Membrane in Pyloric Stenosis by Catheterization. V. Buchtala. Fortschr. a. d. Geb. d. Röntgenstrahlen **87**: 326–329, September 1957. (In German) (Nymphenburger Str. 163, Munich 19, Germany)

Organic stenosis of the stomach outlet caused by a benign or malignant process with ulceration or scar formation is only to a slight degree amenable to medical treatment. In order to evaluate surgery, an exact diagnosis is highly desirable, but the routine filling of the stomach with large amounts of barium mixture is seldom satisfactory. The author has developed a special procedure of examination to be employed in all cases in which a stenosis of the stomach outlet had previously been demonstrated.

A rubber tube about 70 cm. long and about 6 mm. in diameter is introduced through the esophagus so that the lower end is brought as closely as possible in contact with the stenosis. The patient is placed in a horizontal position, and, with the spot-film device in readiness,

20 c.c. of the regular barium meal is injected into the tube by means of a syringe. As soon as the barium splashes against the mucous membrane in the area of the stenosis, spot films are taken in all three oblique projections. Almost always a beautiful demonstration of the mucous membrane in the stenotic area can be obtained. The distortion of the pylorus and even pinpoint-like niches can be visualized, because there is no massive barium filling.

The author presents 3 cases showing the films that made a correct diagnosis possible.

Five roentgenograms.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Functional X-Ray Symptoms of the Small Intestine in Epidemic Parotitis. R. Pannhorst. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 329–334, September 1957. (In German) (Rudolf-Virchow-Krankenhaus, Augustenburger Platz 1, Berlin N 65, Germany)

Intestinal disturbances are common in infectious diseases. They are of particular interest in epidemic parotitis because they may indicate a concomitant involvement of other glands of the digestive system, mainly the pancreas. It has been suggested for a long time that some inflammatory process of the pancreas may often be present in mumps, although the mechanism is not known. This may range from a slight secretory disturbance to the severe symptoms of acute pancreatitis.

Acute inflammatory changes in the pancreas produce often, but not always, characteristic changes in the duodenum demonstrable by gastrointestinal x-ray examination. The descending portion of the duodenum in its upper and middle part is rather thin but, as it continues to join the lower horizontal portion, it widens and forms a broad pool, thus resembling a sprinkling can, without the perforated nozzle, pouring a narrow jet of barium down the duodenum. The narrowing of the descending duodenum is undoubtedly the result of a reflex spasm, while the wide pool, lower down, represents a hypotonic dilatation. This "sprinkling-can phenomenon," while common in acute pancreatic disease, is not pathognomonic. It may occur also in peptic ulcer and cholecystitis.

The author has had an opportunity of doing routine upper gastrointestinal x-ray examinations in children during an epidemic of mumps. He presents 2 cases in which he plainly demonstrated the "sprinkling-can phenomenon." Inasmuch as these young children did not have peptic ulcer, and certainly no gallbladder lesions, it is concluded that acute pancreatic disturbances do occasionally accompany mumps and that the gastrointestinal x-ray examination is a good method of demonstrating them.

Seven roentgenograms.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Nonabsorbable Water-Soluble Contrast Mediums: Their Use in Diagnosis of Intestinal Obstruction. Bernard S. Epstein. J.A.M.A. **165:** 44–46, Sept. 7, 1957. (270-05 76th Ave., New Hyde Park, N. Y.)

In cases of possible intestinal obstruction, when the pattern on the scout film is equivocal, examination with an orally administered water-soluble contrast medium may give additional information as to size and location of various intestinal loops.

Hypaque and Renografin have been used by the author. A 50 to 90 per cent solution produces good opacification in normal adults. The dose is 30 to 90 c.c. Good mucosal detail of the duodenum and proximal jejunum is obtained. The indistinct mucosal pattern distally is attributed to the hygroscopic properties of the contrast medium. The normal transit time through the small bowel is thirty to ninety minutes.

These water-soluble contrast materials are nontoxic; they cannot solidify and they are not absorbed from the gastrointestinal tract.

This type of examination was used in 18 cases. Observations and results are briefly described. One case, diagnosed as incomplete obstruction by this method, was further studied with a barium meal, which yielded more information.

Nine roentgenograms.

B. JAY HILL, M.D.
University of Michigan

Intestinal Obstruction Due to Persimmon Bezoar (Diospyrobezoar). Jefferson R. Edwards, Jr., and Richard F. Riley. Gastroenterology **33:** 499–502, September 1957. (J. R. E., University of Virginia Hospital, Box 147, Charlottesville, Va.)

The authors report the case of a 59-year-old white woman with intestinal obstruction from a persimmon bezoar lodged in the terminal ileum. Roentgen examination showed numerous dilated loops of small bowel with air-fluid levels. At exploration the site of obstruction was found to be 10 in. proximal to the ileocecal valve. The mass measured 4 × 4 cm. There were six smaller masses proximal to the obstructed site. Removal was accomplished by incision, with primary closure. Recovery was uneventful. The case was unusual in that the bezoars had passed from the stomach, through the pylorus, to obstruct the intestine.

Two roentgenograms; 1 photograph.

ROBERT S. ORMOND, M.D.
Dearborn, Mich.

Enterogenous Cyst of the Duodenum. R. L. Duberger. J. Canad. A. Radiologists **8:** 54–56, September 1957. (300 King St., E., Sherbrooke, Quebec)

Enterogenous cysts are considered to be developmental defects, reduplications of the gut which may arise anywhere from esophagus to colon. The cyst cavity is lined with mucosa similar to that of the segment of the digestive tract from which it arises. When the cyst is in the mesentery, its walls are generally found to contain all four layers of the normal gut. When it lies in the wall, as is usually true of duodenal cysts, its outer layer is complete but the inner one consists of mucosa and possibly submucosa, but rarely muscularis. The histologic picture in such cases is pathognomonic, showing two mucosal layers back to back, possibly separated by a common submucosa.

The author's report concerns an enterogenous cyst of the descending duodenum in a fourteen-year-old girl, who had experienced occasional attacks of pain, often associated with vomiting, as long as she could remember. A mass, which would come and go, was palpated. Roentgenologic study demonstrated a smooth filling defect in the descending duodenum over which the mucosal pattern was flattened. Operation revealed an intraparietal enterogenous cyst of the duodenum communicating with the lower end of the common bile duct. Intravenous cholecystography was not done but, in retro-

spect, might have been helpful in making the diagnosis.

Two roentgenograms; 1 photomicrograph.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Management of Symptomatic Aganglionic Megacolon in Early Infancy. William K. Sieber and Bertram R. Girdany. Arch. Surg. **75**: 388–395, September 1957. (3500 Fifth Ave., Pittsburgh 13, Penna.)

The authors report their experience with 30 infants with symptomatic aganglionic megacolon. The data show the serious nature of the condition and indicate that prompt colostomy to relieve obstruction must take precedence over medical and drug therapy.

Aganglionic megacolon is to be suspected in any infant with signs of partial or complete low intestinal obstruction. Abdominal distention is progressive and stools are scanty. Paradoxical diarrhea around fecal impaction occurs. Foul-smelling, frequent stools are an ominous sign, indicating phlegmonous colitis. In 27 of the 30 infants in this series plain films suggested the correct diagnosis. The lateral film of the abdomen shows a tiny-calibered, air-containing rectum, while dilated loops of air-containing bowel distend the abdominal cavity.

Opaque studies define the caliber of the distal colon and the site of transition to dilated bowel. These examinations are carried out with Dionosil-saline mixtures introduced by gentle pressure of a hand syringe through a soft rubber catheter, with its tip in the distal rectum. The contrast studies help the surgeon to plan his operative procedure, particularly with reference to the colostomy site. Introduction of this water-soluble medium in saline suspension is a safe and rewarding procedure. The authors feel that barium mixtures are contraindicated, since the barium becomes inspissated and adds to the obstruction.

Prolonged "conservative" medical treatment predisposes to complication. Prompt colostomy immediately proximal to the area of aganglionosis is the treatment of choice. Colostomy done as an emergency procedure is often life-saving.

Seven roentgenograms; 1 photograph; 4 tables.

THEODORE E. KEATS, M.D.
University of Missouri

Choledochal Cyst, with a Report of an Intraduodenal Choledochal Cyst. Lee S. Serfas and Clinton S. Lyter. Am. J. Surg. **93**: 979–989, June 1957. (C. S. L., 5th General Hospital, APO 154, New York, N. Y.)

A choledochal cyst is not a true cyst but is a localized dilatation or enlargement of the common bile duct, probably of congenital origin. Characteristically, this dilatation is limited to the supraduodenal portion of the duct and is circumferential. It may involve the common duct alone or both the common duct and hepatic duct so that two ducts enter the cyst, separated by a cyst wall.

The choledochal cyst is usually localized, with no evidence of dilatation of the gallbladder, common hepatic or hepatic ducts, or of the common duct distal to the site of the cyst. The etiology is not definitely known, but the most tenable explanation assumes a congenital weakness of the duct wall which can dilate under normal intraductal pressure but may be associated in some cases with partial obstruction due to stenosis secondary to cholangitis or other abnormality.

Approximately 77 per cent of the cysts occur in female patients, and 76 per cent in the first twenty-five years of life. The importance of a preoperative diagnosis is indicated by the fact that in cases recognized prior to surgery the mortality was 36 per cent as compared to 62 per cent in cases incorrectly diagnosed. The triad of abdominal pain, tumor, and jaundice in a young woman should suggest the possibility. Pain is usually in the right upper quadrant of the abdomen but not as severe as that of acute cholecystitis or renal colic. Jaundice, when present, is of the obstructive type and is confirmed by the usual blood, urine, and stool examinations.

With oral cholecystography there is typically no visualization. Intravenous cholangiograms should be diagnostic if good opacification of the choledochus is obtained.

A case is reported of a forty-three-year-old white woman with recurrent symptoms following a cholecystectomy for multiple nonopaque stones. An intravenous cholangiogram showed a normal duct system but the contrast substance in the duodenum outlined a rather large filling defect. A barium study also showed evidence of an intrinsic mass in the second portion of the duodenum. At operation, an intraduodenal choledochal cyst was demonstrated, involving the common duct just proximal to the ampulla of Vater. A large nonopaque stone was found within the cyst.

Six roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Clinical Appraisal of Percutaneous Splenoportography. Marion S. DeWeese, Melvin M. Figley, William J. Fry, Robert Rapp, and Howard L. Smith. Arch. Surg. **75**: 423–433, September 1957. (University of Michigan Medical School, Ann Arbor, Mich.)

The authors report their clinical appraisal of percutaneous splenoportography based on a study of 120 patients over a period of three and a half years. They use an intercostal approach to the spleen, with 70 per cent Sodium Urokon as the contrast medium. If there is no demonstrable bleeding tendency the examination is carried out in the Department of Radiology. An automatic filming device permitting serial exposures at the rate of 1.3 per second has been utilized in three-fourths of these examinations. This is a helpful technical refinement but is not essential to the success of the procedure, as many satisfactory examinations have been accomplished with rapid manual changing of the cassettes.

In a normal subject the bolus of contrast material leaves the spleen and passes rapidly through the splenic and portal veins and the intrahepatic portal ramifications. Finally a diffuse haziness of the liver parenchyma, known as the hepatogram, is observed, followed by rapid clearing of the contrast medium. The entire cycle is usually completed in less than twenty seconds. Normally there is no filling of collateral channels or portal vein tributaries, although there may occasionally be a transient reflux for a short distance into the larger tributaries as the contrast medium is injected under pressure.

In portal hypertension from any cause, there is reverse flow of varying degree into the tributaries and collateral channels of the portal vein. The superior mesenteric, inferior mesenteric, coronary, short gastric, and esophageal veins, among others, may be outlined.

Cirrhosis may be suspected on the basis of roentgenographic demonstration of abnormalities in the size of

the liver, crowding or tortuosity of the larger venous branches within the liver, or attenuation of the peripheral branches. Diagnosis of portal hypertension of intrahepatic origin is based on visualization of collateral channels, patency of the splenic and portal veins, and, less important, the radiologic evidence of cirrhosis mentioned above.

Extrahepatic portal obstruction associated with cavernomatous transformation of the portal vein is revealed by multiple tortuous channels in the region of hepatoduodenal ligament, through which the contrast medium eventually reaches the liver. This is accompanied by filling of the collateral channels, indicating portal hypertension. The diagnosis of portal hypertension due to hepatic vein obstruction cannot be made with finality by splenoportography but may be suspected on the finding of a patent portal vein, distended collateral channels, and normal intrahepatic branching of the portal vein in the presence of normal liver function.

Intrahepatic neoplasms produce blunting of the larger portal branches within the liver or mottled densities in the hepatogram. Extrahepatic neoplasms may cause filling defects of the portal or splenic veins, or complete block, distal to the point of obstruction. Complete obstruction of the splenic vein by neoplasms in the tail of the pancreas may result in nontransit of the contrast medium from the spleen, but this must be evaluated carefully, as it has also been observed in apparently normal patients.

Splenoportography was completed successfully in 84.3 per cent of 134 examinations attempted. Complications of the procedure have not been prohibitive. Serious splenic hemorrhage occurred in one patient. The procedure has little value in the differential diagnosis of jaundice. It is sometimes of aid in the detection of obscure neoplasms of the liver, pancreas, and upper abdomen. It is a useful direct method of determining postoperative patency of portacaval shunts. It is of primary value in the evaluation of patients with portal hypertension, either manifest or occult.

The authors conclude that percutaneous splenoportography is a good, relatively safe procedure which deserves wider acceptance as a specialized radiologic examination in properly selected patients.

Eight roentgenograms; 5 tables.

THEODORE E. KEATS, M.D.
University of Missouri

THE MUSCULOSKELETAL SYSTEM

Skeletal Tuberculosis in Children Treated for Primary and Miliary Tuberculosis. Lillian Milgram. Am. Rev. Tuberc. **75**: 897–911, June 1957. (Department of Pediatrics, New York University College of Medicine, New York, N. Y.)

A study of skeletal tuberculosis in children with primary and miliary tuberculosis followed for at least two years is reported. The incidence of recognizable bone lesions was compared in groups treated with the sulfone Promizole, with streptomycin and isoniazid or with isoniazid alone. It was found that skeletal lesions occurred less frequently under streptomycin and/or isoniazid treatment than under treatment by Promizole. Patients with untreated primary tuberculosis had a higher incidence of skeletal lesions than those who were treated. In the patients with miliary tuberculosis there were no survivors in the untreated group. Five treated with sulfone survived, and in 4 of them bone lesions developed. In a group of 30 survivors of miliary tuberculosis treated with streptomycin and isoniazid, or either of these drugs alone, bone lesions appeared in only 5.

The author believes that this study indicates that the chemotherapeutic agents act on established foci in the bone marrow, since it has been shown that there is widespread bone marrow involvement in patients with miliary tuberculosis. This has been demonstrated repeatedly at autopsy and in biopsy specimens of accessible bones in patients with this disease.

Five tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Cooley's Anemia: A Review of the Roentgenographic Findings in the Skeleton. Hickey Lecture, 1957. John Caffey. Am. J. Roentgenol. **78**: 381–391, September 1957. (Babies Hospital, 167th St. and Broadway, New York 32, N. Y.)

Historical data regarding the clinical recognition of Cooley's anemia as an entity is outlined in this paper. Lawrence Reynolds' early observations of bone changes and his original descriptions of the roentgenographic alterations are still valid and accurate (see Cooley, Witwer, and Lee: Am. J. Dis. Child. **34**: 347, 1927). Basically these changes are enlargement of the medullary cavities and atrophy of the overlying cortex in the long bones and in the tables of the cranial vault. In early cases, the marrow has a mottled spongy appearance, while the later stages are characterized by striking striations in the bony architecture. The pathogenesis of these roentgen manifestations is based on the overgrowth of bone marrow inside elastic and expansile bones so that the enlargement of the medullary cavities occurs at the expense of the cortex.

Since the original reports on this disease were published, certain additional features have been established. The racial incidence has been recognized as much wider than was first assumed. While the bulk of the patients are of Greek or Italian stock, the disease has appeared in persons of other nationality and the diagnosis is no longer to be excluded on the basis of race alone.

Recent advances include also the recognition of a mild form of the disease in adults and of hematologic "traits" in healthy adult carriers. These adult carriers are found in Americans of Greek and Italian descent and are potential sources of perpetuating the more severe types of the disease. The principal findings which indicate the "trait" are: increased resistance of red blood cells to salt solution, mild hypochromic macrocytic anemia, basophilic stippling, and the presence of excessive numbers of oval and target cells.

The recognition of abnormal hemoglobin in chronic hemolytic anemias is an advance that may provide criteria for classifying these various anemias. The abnormal hemoglobin F (fetal hemoglobin) is present in high concentrations varying between 10 and 100 per cent of the total hemoglobin of patients with Cooley's anemia. The combination of Cooley's anemia and other abnormal hemoglobin (such as hemoglobin S in sickle-cell anemia) has been reported.

To the radiographic features in Cooley's anemia originally described by Reynolds, new roentgen criteria have been added. In all severe cases, skeletal growth and maturation are retarded. As the patients progress in age, the bone changes are altered. In the more peripheral parts of the skeleton, where red marrow is re-

placed with fatty marrow, the earlier roentgen changes may disappear completely by puberty. In the skull, spine, and pelvis, in which the red marrow persists through adult life, the roentgen changes become more pronounced after puberty. Thus the hands, which show characteristic roentgen stigmata in infancy, become the least diagnostic sites in the adolescent. The paranasal sinuses may be poorly aerated or nonaerated, owing to the encroachment of marrow overgrowth during the pneumatization stage. The maxillary sinuses are most markedly affected. Hypertrophy of the upper maxilla may lead to overbite on the mandible and ectopia of the central incisors. The characteristic thickening of the calvarium does not affect the segment of the occipital squamosa below the internal occipital protuberance, since this segment is normally deficient in marrow.

In view of the generalized marrow hyperplasia and consequent cortical atrophy, it is surprising that pathologic fractures are infrequent in Cooley's anemia. In some severe cases, localized destruction of bone may suggest the development of localized tumors of red marrow. In one case there were multiple compression fractures of the vertebral bodies, which are probably related to this phenomenon. However, this pathologic change is unusual. When fractures do occur, it is most often in the femora in children; in older persons fractures of the fibula, metatarsals, radius, and spine have been observed.

Gallstones are also complications of Cooley's anemia; their incidence increases with age, and probably with the frequency of blood transfusions.

Seventeen roentgenograms; 7 photographs; 1 drawing.

JOHN W. WILSON, M.D.
Johnstown, Penna.

Late Bone Changes in Caisson Disease, with a Case Report. C. Rotenberg and A. R. McGee. J. Canad. A. Radiologists **8:** 50–53, September 1957. (C. R., 167 College St., Toronto 5, Ontario, Canada)

Caisson disease or "the bends" represents the body injury due to extreme atmospheric pressure reduction or "decompression." It may be the result of rapid decompression from a highly pressurized state, as in deep-sea diving or tunnel work, or from a normal state as in a swift aeronautic ascent.

With an increase of atmospheric pressure, there is increased absorption of gases in the tissues, especially in fatty tissues. When decompression takes place too quickly, the lungs are not able to excrete the excess of nitrogen, although the oxygen that is released by decompression is effectively taken up by hemoglobin. Bubbles of nitrogen flood the blood stream, acting as emboli, and giving rise to multiple infarctions. Since fatty tissues have the greatest potential for absorbing nitrogen, high-lipid tissues show more frequent involvement, *viz.*, bone marrow, brain, spinal cord, and mesentery.

Bone infarcts are not visible by x-ray until macroscopic quantities of mineral are precipitated or until the necrotic area has been demarcated. Roentgenographic findings are therefore a late manifestation. Infarcts in tubular bones are most frequently found in the epiphyses and at the ends of the shafts. There is a predilection for the upper ends of the humerus, femur, tibia, and fibula and the lower end of the femur. Where the articular surface of a bone is involved, a degenerative arthritis may result.

In the case reported here, typical skeletal changes were observed twenty-five years after the causal accident, which occurred in a single morning's employment in a sewer project.

Six roentgenograms.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Hypophosphatasia. Guido Currarino, Edward B. D. Neuhauser, Gertrud C. Reyersbach, and Edna H. Sobel. Am J. Roentgenol. **78:** 392–419, September 1957. (E. B. D. N., Children's Medical Center, 300 Longwood Ave., Boston 15, Mass.)

Hypophosphatasia is a familial disease primarily affecting children, characterized by defective bone formation associated with low alkaline phosphatase activity in serum and tissues. The disease resembles rickets, but certain data justify its acceptance as a separate entity. Thirty-three cases have been collected (some of which have been reported elsewhere), and on the basis of this series the clinical, histologic, radiographic, and laboratory manifestations are discussed.

The severity of the disease bears an inverse relationship to the age at the time of onset of the clinical manifestations, *i.e.*, the older the child the less severe are the symptoms. Of 6 infants in whom a diagnosis was made at birth, all died in the early neonatal period, 5 within the first hour of life. In cases in which hypophosphatasia was not recognized until several days postpartum, the skeletal deformities were less pronounced, but the disease process was still severe, being characterized by irritability, jerky movements or convulsions, delayed growth, cyanosis, anorexia, vomiting, constipation, loud cries, and fever. In 14 cases, the symptoms appeared between the first and sixth month of life after a period of apparent good health. In these cases, the clinical manifestations included anorexia, vomiting, constipation, failure to grow, recurring febrile episodes, irritability and hypotonia, convulsions, cyanosis, and episodes of loud cries. The cranial sutures were separated, with bulging, tense anterior fontanelles; a rachitic rosary and enlargement of the ends of the long bones were present in most cases. Five of these patients died between the eighth and tenth month of life and a sixth died at twenty-nine months. Ten patients came under observation between the seventeenth month and thirteenth year of life, although some of these showed evidence of mild manifestations earlier in childhood. The usual complaints in this group were defective gait, knock-knees, painful extremities, marked dental caries with premature loss of deciduous teeth, delayed onset of walking, and occasionally a short stature. A rachitic rosary and enlargement of the ends of the long bones were prominent features. Craniostenosis was demonstrated in a single instance. None of these patients died during the period of observation; and in some, gradual improvement was observed.

The most significant laboratory finding was a decreased serum alkaline phosphatase. Histochemical or biochemical examinations demonstrated abnormally low alkaline phosphatase in bones, kidneys, and other tissues. The serum calcium was elevated in the newborn, but in only 3 of the older patients. The serum phosphorus was essentially normal. Ethanolamine phosphoric acid, an amino acid which is not present normally, was found in the urine of all patients on whom appropriate investigations were made.

The basic roentgen manifestation, common to all patients, was diminished irregular bone formation in the

presence of continuing preosseous tissue proliferation. In the newborn, the changes were diffuse and marked. Many parts were wholly uncalcified or were ossified only in their central portions. These bones were short, thin, and coarsely trabeculated. In some long bones, the metaphyseal areas were irregularly ossified, and poorly calcified material was left behind in the growth process. Metaphyseal infractions were common. The deformity and diminutive bone lengths noted clinically were in many respects related to angulations and fractures with abundant callus. In the patients showing clinical manifestations of hypophosphatasia during infancy the roentgenographic findings were in general less severe than in the newborn group. Angulation of the long bones was observed, and there were variable degrees of metaphyseal rarefaction and an indistinct zone of provisional ossification. The epiphyseal lines were wide and irregular, and metaphyseal infractions were accompanied by new subperiosteal bone formation. The diaphyseal margins were irregular and indistinct, and a mottled sclerosis was apparent in small centers of ossification. Epiphyseal ossification was delayed. The cranial bones were demineralized, and the sutures were wide, with soft-tissue bulging in the anterior fontanelle. The healing process was accompanied by premature closure of the sutures with variable degrees of craniostenosis and, in the long bones, by remineralization of the metaphyses and secondary ossification centers and gradual molding of the shafts. In a few instances, the healing process was complete in the long bones; other patients showed a persistent widening of the epiphyseal line with irregular demarcations extending into the metaphyses. Coarsening of the trabecular pattern and undertubulation usually remained.

In the patients who were first examined during childhood (from seventeen months to thirteen years) the bone abnormalities were well established. The distal ends of the femora and upper ends of the fibulae and humeri were most commonly affected. Flaring of the ribs and scalloping of the iliac crests and scapulae were common. Wide uneven epiphyseal lines with radiolucent tissue extending into the adjacent metaphysis, coarse trabeculation, shortening of the extremities, and defective teeth were initial observations encountered in this group and are similar to the findings in infants in the healing phase. As these childhood cases were followed roentgenographically, the process remained unchanged or in some instances subsided slowly.

A total of 7 autopsies have been performed on patients in the newborn and infantile groups, and in 3 other patients bone biopsies were done. On the basis of this material, the pathologic changes are discussed at length. Characteristic findings are limited to the kidneys and bone. In the kidneys, a low grade inflammation with scarring and peritubular and tubular calcific deposits were demonstrated. The pathologic study of the bones was similar in all cases and varied only in degree. The cranial bones were soft and the sutures grossly appeared to be fibrous with well defined margins at each cranial bone. Histologically, the fibrous tissue contained osteoid. The long bones were soft and bowed, showing multiple fractures with callus formation. At the epiphysis, the nonproliferative cartilage was normal, whereas the proliferating cartilage cell zone was wider than usual and the hypertrophic cell zone was wide and irregular. Long tongues of cartilage cells reached far into the diaphyseal marrow. The metaphyseal zone was markedly distorted by previous fractures in repair with large amounts of osteoid constituting the predominant tissue. The diaphyses showed a primitive cancellous structure with wide zones of subperiosteal new bone proliferation over the cortex. Stains for alkaline phosphatase elicited little or no activity, and these findings were verified microchemically in several instances.

The pathogenesis of hypophosphatasia is not yet clear but is probably related to the low phosphatase. The familial incidence of the disease and the finding of low phosphatase in many of the parents suggest that the deficiency is congenital in nature and genetically determined.

Death in the newborn is usually related to respiratory failure, possibly secondary to poor ossification of the bony thorax. In older infants, death is attributed to renal involvement. In those who survive the first year, improvement is to be expected although prominent skeletal deformities remain. The ultimate fate of these children and their offspring is not known.

Case reports are included.

Thirty-nine roentgenograms; 6 photographs; 2 photomicrographs; 1 table.

JOHN W. WILSON, M.D.
Johnstown, Penna.

Osteogenesis Imperfecta Diagnosed in Utero. Lewis A. Gillanders. Brit. J. Radiol. **30:** 500–503, September 1957. (Radiodiagnostic Department, Glasgow Royal Infirmary, Glasgow, Scotland)

The author reports a sporadic case of osteogenesis imperfecta diagnosed *in utero* and follows it by a short survey of the available literature.

A scout film of the abdomen showed a single fetus in breech presentation. The size of the fetus suggested a pregnancy of thirty-four to thirty-six weeks. Calcification was deficient, and there was poor definition of the upper limbs, apparently due mainly to osteoporosis. One humerus was fractured. The lower limbs overlay the maternal sacrum and were not well defined. Some stunting of the bones appeared to be present. The cranial bones were thin and it was the opinion of the radiologist that the general appearance was highly suggestive of osteogenesis imperfecta. Roentgenograms obtained following delivery showed the typical features of the disease.

A careful scrutiny of the antenatal radiographs is essential to elicit the diagnostic features of this condition which are: poor skeletal calcification, numerous fractures, and short, deformed limb bones. To be considered in the differential diagnosis are the following:

(1) Fetal death: In this case Spalding's sign and the characteristic collapse of the skeleton would be expected before demineralization was sufficiently marked to cause confusion.

(2) Chondrodystrophy: The long bones are short and stumpy, but demineralization and fractures are not encountered.

(3) Anencephaly: Ossification is often heavy. The skull base is malformed and relatively dense.

(4) Achondroplasia: The long bones are short and broad but the skeleton is normally calcified and there are no fractures.

(5) Cleidocranial dysostosis: The skull vault is poorly calcified and a mosaic type of ossification is also found in this condition. The remainder of the skeleton, however, will show a normal density.

(6) Ectromelia: Skeletal calcification normal.

(7) Hydrocephalus: Calcification of the skeleton is normal.

Four roentgenograms; 1 photograph.

THEODORE E. KEATS, M.D.
University of Missouri

Lumbar Myelography in Diagnosis of Disk Hernia. M. S. Del Buono. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 334–342, September 1957. (In German) (Roentgen Diagnostic Central Institute of the University of Zurich, Canton Hospital, Zurich, Switzerland)

The author reports the results of lumbar myelography in 1,525 patients, of whom 373 were operated upon. A water-soluble-contrast medium (Kontrast U Lundbeck) was used and the technic described by Lindblom was closely followed (see Acta radiol. **34:** 321, 1950. Abst. in Radiology **57:** 612, 1951).

The clinical determination of the level of disk involvement is based on the projection of pain and on disturbances of sensation, motility, and the reflexes. With herniation between L-4 and L-5, disturbances of sensation are noticed in the dermatome L-5 and perhaps in S-1; motor disturbances should be weakness of dorsiflexion of the foot and of the great toe. If the trouble is between L-5 and S-1, sensation is impaired in the dermatome S-1, and the lateral edge of the foot and the outer three toes are affected. Motor disturbances should be weakness of plantar flexion of the foot and the great toe; the Achilles tendon reflex is diminished or abolished.

As a result of his observations in the series of 373 patients treated surgically, the author has been able to prove that in many cases the above mentioned neurological signs are partially absent or distorted. This fact adds to the importance of the myelographic examination. In the 373 surgical cases positive myelographic findings were correct in 82.7 per cent. Herniation was diagnosed but the level was incorrect in 4.6 per cent. In 9.3 per cent the myelographic study was negative but disease was found. In 1.6 per cent the clinical findings suggested disk involvement but operation proved the negative myelographic observations to be correct.

In the author's opinion, with proper care, complications should not be more severe than those following an ordinary lumbar puncture.

Three roentgenograms; 2 drawings; 5 tables.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Premature Growth Arrest of the Knee Epiphyses. Don E. Matthiesen. Am. J. Roentgenol. **78:** 499–501, September 1957. (926 E. McDowell Road, Phoenix, Ariz.)

Premature growth arrest at the level of the distal femoral or proximal tibial epiphyseal plate may result in unequal leg length, genu varum, and knock-knee. These deformities are preventable if the primary growth arrest of the epiphyseal plate can be detected in time for appropriate surgical treatment.

The arrest may be due to a crushing of a portion of the plate in a fall or to faulty gait such as frequently follows hip joint disease. A bony bridge forms between the epiphysis and metaphysis at the site of the cartilaginous interruption. This is seen most commonly in the posterior medial quadrant of the proximal tibial plate and just posterior to the central portion of the epiphyseal plate of the distal femur.

Radiographic changes include thinning of the disk of epiphyseal cartilage and the presence of a transverse zone of dense bone on the metaphyseal side. Bony striations crossing the central part of the cartilage plate may be seen and later there may be trabeculae which converge toward the site of the bony bridge, producing a stellate appearance. The line of the epiphyseal plate may become bent, forming an inverted V in the distal femur or a deepening of the intercondylar notch.

When the changes noted above are seen, comparative views of the normal side are indicated and are helpful in making a definitive diagnosis.

Five roentgenograms.

J. A. GUNN, M.D.
Grand Rapids, Mich.

Roentgenologic Features of Fracture of the Tibial Tuberosity (Osgood-Schlatter's Disease). Bengt Hulting. Acta radiol. **48:** 161–174, September 1957. (Roentgen Department, Children's Clinic, Karolinska Sjukhuset, Stockholm, Sweden)

A study was undertaken of the variations in the roentgenologic anatomy of the tibial tuberosity of 434 children from seven to fourteen years of age. In almost all cases both knees were examined. The tibial tuberosity was classified according to its degree of ossification. In 209 cases it was still in the cartilaginous stage. The appearance varied little from individual to individual. In 9 cases a cartilaginous stage on one side was associated with beginning formation of a bony apophysis on the other side. In the late cartilaginous stage, a bony projection from the anterior lower part of the tibial epiphysis was generally observed.

In 60 cases a bony apophysis had formed. The appearance of the tuberosity varied greatly owing to the differences in the number of ossification centers, their shape, and size. A small thin bone center in the lower part of the tuberosity or occasionally beside the epiphyseal projection, represented initial ossification; later, a large center was visible in close contact with the tibial epiphysis. When several bone centers were present, they frequently varied in size, the largest lying most caudally and anteriorly. They were most often arranged in a row, and a line joining their anterior border then formed a continuation of the anterior contour of the epiphysis. In 5 cases the apophyseal stage was represented on one side and the bony stage, in which the apophysis had united with the epiphysis, was present on the opposite side. In about one-third of the cases, the apophyses had essentially the same appearance on both sides.

The bony stage, in which the apophysis had united with the tibial epiphysis, was observed in 171 cases. In the lateral view, the typical tongue-shaped process formed a more or less marked anterior convexity.

Roentgenograms of the knees of 75 patients with a clinical diagnosis of Osgood-Schlatter's disease were evaluated. The average age of onset was twelve years in boys and ten years in girls. In 67 of the cases, repeated roentgenologic examinations were made in the course of treatment, with follow-up radiographs from six months to four years after the first examination.

In 3 cases the tuberosity was in the cartilaginous stage. In these patients there was swelling of the soft tissues at the site of the tuberosity.

In 17 cases the tuberosity was in the apophyseal stage. In 14 of these, various changes in the ossified part of the tuberosity were observed in addition to soft-tissue swelling. These consisted of an irregularity in the bone

structure, irregularly distributed sclerotic shells, fragment-like shells slightly anterior to the bone center, and in 2 cases a transverse fracture.

In 55 cases the tuberosity was in the bony stage. In 37, relatively uniform changes in the initial roentgenogram. These were swelling of the soft tissue over the tuberosity and one or several fragments in front of it. The involved fragments, which were invariably displaced forward and upward, varied in both size and shape. Repeated examinations were made in 43 of these 47 cases. During immobilization in plaster, the space between the avulsed fragment and the tuberosity was observed to become successively filled by callus and newly formed bone. This resulted in a deformation of the anterosuperior aspect of the tuberosity. In 14 cases, also, one or more ossifications were present in the soft tissues adjacent to the tuberosity.

The author believes that the changes seen in patients with Osgood-Schlatter's disease are best explained by the assumption that they represent the sequela of a fracture of the tibial tuberosity.

Twenty-one roentgenograms; 1 table.

H. L. STEINBACH, M.D.
University of California, S. F.

THE SPINAL CORD

Dermoid Tumour of the Spinal Cord. K. S. Bose. J. Indian M. A. **29:** 63–64, July 16, 1957. (39, Poddupukur Road, Calcutta 20, India)

Most tumors of the spinal cord are meningiomas or neurofibromas; dermoids have been encountered but rarely. A case of a huge intradural and extramedullary tumor of a dermoid nature is reported. The patient was a 35-year-old man with progressive wasting of the muscles of the lower extremities, more on the left, for two years; he was unable to walk unaided. Roentgenograms of the spine showed (1) erosion of the posterior aspect of D-11 and D-12 and of all the lumbar vertebrae; (2) widening and destruction of the articular processes; (3) intact intervertebral disks; (4) expansion of the laminae. This picture suggested a space-occupying lesion of the spinal cord, and myelography and lumbar puncture were considered unnecessary.

At operation a variegated pultaceous mass was found, filling an elongated subdural sac which extended from the tenth dorsal to the first sacral vertebra. The sac wall was very thin and the tumor completely covered the lower end of the spinal cord and cauda equina. The mass was scooped out completely. Section of the cyst wall revealed stratified epithelium (epithelial cyst); the contents consisted of an "amorphous mass."

GYNECOLOGY AND OBSTETRICS

Cineradiography of Female Pelvic Organs. A Preliminary Report on a New Method. Hans Lehfeldt, Gottfried Neumann, and Robert W. Carlin. Am. J. Obst. & Gynec. **74:** 413–418, August 1957. (H. L., 784 Park Ave., New York 21, N. Y.)

The authors describe their technic of cineradiography of the female pelvic organs, a new type of hysterosalpingography which they feel offers certain advantages. Using 16-mm. film, they take an x-ray movie of the uterus and tubes under simultaneous fluoroscopic visualization. The patient thus has the advantage of fluoroscopy without exposure to additional radiation and with the possibility of injection of a minimum amount of contrast material. The time required for the examination is short as compared with routine hysterosalpingography; the procedure can be completed within two or three minutes, and the patient thus suffers less discomfort. A permanent record of the findings is obtained and study of the physiology of the uterus and tubes is facilitated. The complete sequence of uterine and tubal behavior is pictured, whereas only momentary phases can be seen in isolated or serial films, with which capturing of the decisive moment is entirely subject to chance in timing of the exposure. It is its independence of this chance factor that is the most important advantage of the new method.

The report is a preliminary one, and further improvements in technic are planned.

Four illustrations.

Problems of Contrast Media in Hysterosalpingography. K. Fochem. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 342–343, September 1957. (In German) (Spitalgasse 23, Vienna IX, Austria)

The author has used a new water-soluble contrast material for hysterosalpingography, called Endografin. The product is an aqueous solution of N,N′-adipic-di-(3-amino-2,4,6-triiodo-benzoic acid) as a methylglucamine salt. The iodine is in a 70 per cent solution and therefore affords strong contrast. The viscosity is determined solely by the large size of the molecule and by the concentration.

It is felt that Endografin is of just the right consistency. It is so thin, in comparison with other preparations, that no special pressure is necessary to inject it. It is tolerated without pain; it mixes well with the body fluids. It resorbs quickly and does not produce iodism (skin rash, rhinitis, etc.) because the iodine is in a very stable compound. The films are "contrasty" and clear. In none of the cases have any complications been observed.

In order to test the reaction of the tissues to Endografin the author has injected the preparation into the abdominal wall and the abdominal cavity of rats, which were killed at various intervals afterwards. Twenty-four hours after the injection he found no evidence of reaction in the tissues. He considers Endografin a superior medium for hysterosalpingography.

[*Abstractor's Note*: Endografin is not yet available in the United States. It may be obtained through the German firm of Schering A.G., Muellerstrasse 170–172, Berlin N. 65, Germany. The American firm Schering has no longer any connection with the German firm of the same name.]

McCann and Menzies of Liverpool, England, reported a series of hysterosalpingographies in which Endografin was used. They described the medium as chemically identical with Biligrafin, though the concentration differs (J. Obst. & Gynaec. Brit. Emp. **64:** 416–418, 1957. Abst. in Radiology **70:** 617, 1958).

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Intravaginal Measurement of Radiation Dose Incident to X-Ray Pelvimetry and Hysterosalpingography. Robert Berman and Benjamin P. Sonnenblick. Am. J. Obst. & Gynec. **74:** 1–12, July 1957. (Newark Beth Israel Hospital, Newark 8, N. J.)

Actual measurements in roentgens of radiation dosage in the female pelvis are presented on 28 women sub-

jected to pelvimetry and hysterosalpingography. Braestrup instruments calibrated for the usual radiation quality range of these studies were used. Sealed ionization chambers were placed in the posterior vaginal fornix, one recording for each exposure and one in place throughout the procedure to record the cumulative dose. The factors of 60–85 kv with 0.5 mm. aluminum filter added were used; the half-value layer at 85 kv was 1.2 mm. Al.

Four routine views were employed in pelvimetry, with the measured total intravaginal dose being 2.1 to 4.4 r (average of 2.9 r) per patient. Hysterosalpingography was done by fractional injection of the contrast medium with five to seven exposures. Fluoroscopy was not used. The intravaginal total dose ranged from 2.5 to 4.5 r per patient with a 3.5 r average.

Five roentgenograms; 2 photographs; 6 tables.

ROBERT L. EGAN, M.D.
University of Texas, Houston

Pyelographic Changes in Pregnancy. A. S. Bligh. Brit. J. Radiol. **30:** 489–492, September 1957. (Cardiff Royal Infirmary, Cardiff, Wales)

Fifteen primiparae, with no previous history of renal disease, were studied by intravenous pyelography: first when under three months pregnant, next within ten days of delivery, and finally three months after the second pyelogram. Only 5 subjects showed a recognizable change. Two of these were followed up with a fourth pyelogram. It is concluded:

(1) Changes in the calyces and pelves are not common in primiparae during pregnancy: such changes as do occur do not persist to a degree likely to give rise to chronic renal infection after delivery.

(2) The findings of dilatation of the renal pelves and calyces, especially on the right side, during pregnancy are not themselves pathological.

(3) The persistence of these changes is not necessarily pathological unless associated with both the clinical history and findings of chronic pyelitis.

(4) No useful information can be obtained from the study of the ureters in these cases by intravenous pyelography.

It is considered that pyelographic abnormalities are likely to be due to a preceding pregnancy when (1) a history of renal symptoms and signs following a normal pregnancy and delivery is obtained; (2) when the pyelographic findings differ on the two sides, the right being more severely affected than the left; (3) when there are no other findings to explain the discovered changes.

Six roentgenograms; 1 table.

THEODORE E. KEATS, M.D.
University of Missouri

Fetopelvic Grading of Breech Presentations. D. Frank Kaltreider. J.A.M.A. **165:** 132–135, Sept. 14, 1957. (University of Maryland School of Medicine, Baltimore, Md.)

The author has analyzed 634 cases of single pregnancy breech presentations. Exclusion of fetal death *in utero*, patients with hemorrhage or toxemia, prematurity, congenital anomalies, and erythroblastosis reduces the fetal loss in this group to 2.3 per cent in service patients and to zero in private patients [number of patients in each group not given]. The author bases his discussion and conclusions on the total 634 cases, with an overall fetal loss of 23.3 per cent.

Selection of type of delivery is determined by pelvic size, pelvic shape, and estimated fetal weight. Pelvic size is accurately measured by x-ray pelvimetry. Roentgenograms contribute to clinical evaluation of pelvic shape. Fetal weight is estimated from the average of four or more independent examiners' estimates. On the basis of these three variables, the patients may be graded for decision as to vaginal or abdominal delivery, according to the following table.

FETOPELVIC GRADING IN BREECH PRESENTATIONS*

Pelvic Size (Mengert's Area)	Pelvic Shape	Estimated Fetal Weight, gm. (lb.)
0 Over 90%	0—gynecoid	0 Premature under 2,500 (5.5)
1 90% to 85%	0—anthropoid	1 Small 2,500–3,100 (5.5-7)
2 85% to 80%	2—platypelloid	2 Average 3,100-3,600 (7-8)
3 79% and under	2—android	3 Large over 3,600 (over 8)

* Grading of 0 to 4 indicates vaginal delivery and 5 and over indicates cesarean section, with following exceptions: (1) platypelloid pelvis with obstetric conjugate greater than 10 cm. is graded 0; (2) transverse diameter less than 10.5 cm. in anthropoid pelvis is graded 2; and (3) any infant weighing over 4,000 gm. should probably be delivered abdominally.

There are two other major considerations that cannot be weighted satisfactorily. One is the behavior of the sacrum. If the sacrum has a good hollow and inclines posteriorly, one can expect little difficulty with the head. If the sacrum is straight and inclines forward, shortening the anteroposterior diameter of the outlet, then one can expect difficulty with extraction. The second consideration is uterine inertia. When there is a combination of a suspect pelvis and inertia, regardless of the presentation, cesarean section is the better part of valor.

One diagram; 6 tables.

B. JAY HILL, M.D.
University of Michigan

Mobile Lithopedion—A Chance Discovery in Routine X-Ray Examination. Edward J. Krol, Vincent J. Galante, and George J. Rukstinat. Illinois M. J. **112:** 125–128, September 1957. (2700 W. 69th St., Chicago, Ill.)

A lithopedion with marked mobility was discovered by chance on x-ray examination of a patient with duodenal obstruction due to carcinoma of the stomach. At operation, the most distal omentum was found to be attached to the anterior abdominal area of the lithopedion (three to four months gestation). The carcinoma of the stomach proved to be inoperable, and a palliative gastrojejunostomy was performed for relief of the duodenal obstruction. The lithopedion was removed. It was believed to be the result of an ectopic gestation due to rupture of a fallopian tube thirty-seven years previously. The attachment to the omentum indicates the probable vascular supply to the fetus and the lack of obstructive symptoms as the lithopedion formed.

Four roentgenograms; 1 photograph.

THE GENITOURINARY SYSTEM

Cineradiography in Urinary Tuberculosis. F. G. Greenwood. Brit. J. Radiol. **30:** 493–496, September 1957. (Hillingdon Hospital, Uxbridge, Middlesex, England)

The author discusses the use of cineradiography in urinary tuberculosis. At the present time this procedure cannot be regarded as more than an auxiliary investigation, useful at a certain period of sanatorium and antibiotic treatment. In the initial diagnosis the well tried methods of bacteriology, cystoscopy, and conventional pyelography are fully adequate in practically all cases, and cineradiography is not likely to give any additional information of value.

In the assessment of progress, the routine pyelographic examinations have some disadvantages. The intravenous technic does not ensure filling of all parts of the tract with contrast material in sufficient concentration. With retrograde pyelography this disadvantage is overcome, but on the small number of films obtainable, often with limited or no screen control, it may be impossible to differentiate between normal contraction and spasm and between spasm and fibrous stricture. The distinction between these conditions may, however, be very evident in the numerous and continuous pictures afforded by cineradiography. The three sites of primary interest are the neck of the calyx, the pelviureteric junction, and at or near the ureterovesical junction.

Twenty-four roentgenograms; 1 drawing.

THEODORE E. KEATS, M.D.
University of Missouri

Apparently Unilateral Polycystic Kidney. A Cause for Abdominal Calcific Shadows. Victor Menashe and D. R. Smith. J. Dis. Child. **94:** 313–317, September 1957. (6510th U. S. A. F. Hospital, Edwards Air Force Base, Calif.)

The authors report a case of unilateral polycystic kidney in an infant of four months. Calcific deposits over the right renal area had been demonstrated earlier on a plain film taken for another purpose. Laboratory tests were normal. Intravenous pyelography showed nonfunction of the right kidney, and retrograde study indicated lack of communication between the lower right ureter and renal pelvis. Nephrectomy revealed the kidney to be almost entirely replaced by bluish cysts. Several branches of the renal vein contained phleboliths.

Unilateral polycystic kidney is a rare condition but has been noted at autopsy. Most authors consider this diagnosis invalid until the apparently normal kidney has been examined pathologically or proved normal by the indirect method of long-term follow-up. Differentiation between polycystic and multilocular cystic kidney should be made.

Three roentgenograms; 1 photograph.

J. S. ARAJ, M.D.
Toledo, Ohio

Nephroblastoma (Wilms' Tumor); Case Report. H. Annamunthodo and R. F. Hutchings. J. Urol. **78:** 197–204, September 1957. (University College Hospital of the West Indies, Jamaica, B. W. I.)

Wilms' tumor has been reported as occurring *in utero*, in fetuses, and in the newborn. The majority of cases, however, are seen between the ages of three and four. Earlier diagnosis, with earlier treatment and better results, would ensue from more careful examination of infants and young children with special reference to the presence of a flank mass. To wait for an obvious mass deforming the abdomen or for hematuria, which appears late, is to invite therapeutic failure.

Excretory pyelography is indicated in every case. A distorted calyceal system or failure of excretion by the involved kidney may be demonstrated, but the chief value of the procedure is to ascertain the presence and functional status of the contralateral kidney. A chest film is a must before treatment to rule out pulmonary metastases.

In the case reported by the authors the diagnosis was strongly suggested by physical examination at the age of six days and was promptly confirmed by intravenous pyelography (15 ml. of 35 per cent Diodone injected into the sagittal sinus) repeated on each of two successive days. At ten days of age, the patient was operated upon *via* an extraperitoneal approach under Novocaine (10 ml. of the 0.5 per cent solution). He was apparently well some thirty-one months after surgery.

Two roentgenograms; 1 photomicrograph; 1 photograph; 2 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Hypernephroma in a Pelvic Kidney Demonstrated by Angiography. Report of a Case. Osborne Bartley. Acta radiol. **48:** 175–180, September 1957. (Roentgen Department III, Sahlgrenska Sjukhuset, Gothenburg, Sweden)

A case of ectopic left kidney in the pelvis, superimposed upon the sacrum and containing a hypernephroma, is presented. Urography disclosed no obvious deformation of the pelvis. Renal angiography was performed by means of a percutaneous puncture of the right femoral artery with the insertion of a catheter. This revealed a large vascular neoplasm in the kidney and a metastatic lesion in the bony pelvis.

In a survey of intravenous urograms performed in 10,500 patients, the author found 9 cases of renal ectopia. Among these were 5 cases of pelvic kidney. Only 10 cases of a malignant growth occurring in an ectopic kidney could be found in the literature.

Four roentgenograms; 2 photographs.

H. L. STEINBACH, M.D.
University of California, S. F.

Thorotrast Damage of Kidneys with Hypertension. H. U. Zollinger. Schweiz. med. Wchnschr. **87:** 1089–1091, Aug. 24, 1957. (In German) (Pathological Institute of the Canton Hospital, St. Gallen, Switzerland)

The author describes a case of Thorotrast accumulation and retention in the subpelvic region of the kidney and renal tissue, following retrograde pyelography with pyelorenal reflux. Thirteen years after the pyelographic examination, hypertension developed, with considerable pain, necessitating a right nephrectomy. Thereupon the hypertension improved, but recurred several months later. The kidneys showed deposits of Thorotrast with perivascular granuloma formation and lesions of the arterioles, similar to arterial changes observed following irradiation. It is assumed that the hypertension is entirely of renal origin, secondary to radiation damage from Thorotrast deposits.

Two roentgenograms; 5 photomicrographs.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Delayed Cystography in Children. Harold Fulton. Am. J. Roentgenol. **78:** 486–491, September 1957. (Harper Hospital, Detroit 1, Mich.)

Vesical ureteral reflux occurs rarely in normal unanesthetized subjects. It is therefore of significance, particularly in upper urinary tract infections of infants and children. Demonstration of such reflux may be accomplished by retrograde cystography, voiding cystography, postvoiding cystography, injection of "ascendant" Lipiodol into the bladder (Young, Anderson, and King: J. Urol. **75:** 263, 1956. Abst. in Radiology **67:**917, 1956), or delayed cystography. This last procedure appears to be the most reliable and the simplest one but should be coupled with a postvoiding cystogram for maximum demonstration of vesicoureteral reflux.

Water-soluble contrast material is introduced into the bladder through a small Foley-type retention catheter. The amount used is that sufficient to produce slight discomfort, or a maximum of 150 c.c. Films are obtained at five, ten, twenty, thirty, forty-five, and sixty minutes, and a postvoiding film is taken after withdrawal of the catheter, at which time the child usually voids spontaneously.

The reflux may be immediate, delayed, or present only after voiding, and may be unilateral or bilateral. The volume varies from a minimal amount seeping into the lower ureter to a considerable quantity passing back into the upper urinary tract. The demonstration by delayed cystography of startling degrees of reflux in pediatric patients in whom infection cannot be explained by cystourethroscopy, excretory urography, or retrograde pyelography may lead to a new therapeutic approach, with satisfying results.

Very occasionally a normal child will have vesicoureteral reflux but this can be distinguished from the significant type as it is unilateral, transient, usually cannot be reproduced on subsequent examinations, and is not associated with dilatation of the ureter or pelvis.

Three cases with representative roentgenograms to demonstrate the pertinent features are included in this article.

J. A. GUNN, M.D.
Grand Rapids, Mich.

The Roentgenographic Diagnosis of Cystitis Emphysematosa. Emil J. Ganem, Joseph Calitri, and H. Spencer Glidden. J. Urol. **78:** 245–251, September 1957. (E. J. G., 301 Essex St., Lawrence, Mass.)

Gas in the wall or within the lumen of the urinary bladder has been described a number of times. The condition is usually produced by gas-forming bacteria of the colon group and is often associated with diabetes mellitus or hyperglycemia due to intravenous fluid therapy. Three stages are recognized in the formation of gas in the bladder to produce cystitis emphysematosus. First, there is a production of tiny intramural, radiolucent vesicles by gas producing bacteria appearing on the film as a clear halo around the bladder. As the condition progresses, the intramural vesicles become more distended with gas and there is accompanying irregular swelling of the bladder wall with diminution in the lumen. In the final stage the vesicles rupture and discharge their gas into the bladder lumen so that a gas cystogram may be demonstrated on the films.

Two cases in diabetics are presented with evidence that the stages of cystitis emphysematosa may progress as described above. The gas produced by the responsible organisms was studied in one case and identified as carbon dioxide.

Four roentgenograms; 1 photomicrograph; 1 diagram.

SAUL SCHEFF, M.D.
Boston, Mass.

THE ADRENALS

Radiologic and Stratigraphic Study of Adrenal Tumors; 11 Cases, 3 of Them Bilateral Forms. M. Giraud, P. Bret, M. Kuentz, A. Anjou, G. Costaz, and L. Chollat. J. de radiol. **38:** 893–904, September-October 1957. (In French) (Lyons, France)

The authors demonstrated 11 adrenal tumors in 100 stratigraphic studies following induction of pneumoretroperitoneum. Sixty of the examinations were performed in patients with ordinary hypertension. Intravenous urography was combined with the above procedures to aid in accurate localization of the kidneys and to show the relation of the adrenal tumor to the kidney on the same side.

Three patients had bilateral tumors; 1 had four tumor masses. The radiologic procedures described are of especial value before surgery, when hyperplasia or tumor of the adrenal glands is suspected on the basis of clinical and laboratory studies.

Eleven roentgenograms; 3 photographs; 11 diagrams.

CHARLES M. NICE, JR., M.D., Ph.D.
Tulane University

TECHNIC

Tomokymography. G. Ivanov, B. Botev, and L. Minkov. J. de radiol. **38:** 944–947, September-October 1957. (In French) (Sofia, Bulgaria)

An apparatus has been designed which combines the principles of tomography and kymography. The combination may give a good result only when the kymographic grid is synchronized with the movement of tomography in such a way that exposures of parts of the film have a width of interstices of the roentgen tube throughout its movement, ordinarily 30 to 50 degrees. In other words, if the width of the openings in the kymographic grid is 1.0 mm. while that of the intervals of lead is 12.0 mm., and if the displacement of the grid lasts 3.0 seconds, the tomographic tube, for these 3.0 seconds, must make 12 movements with an inclination of 30 to 50 degrees. In the authors' apparatus, the roentgen tube and the kymograph move in a parallel and circular manner, while the object is between the two on the axis of rotation.

Two tomokymographs; 1 photograph; 3 diagrams.

CHARLES M. NICE, JR., M.D., Ph.D.
Tulane University

Segmental Roentgenography by Means of a Standard Tomographic Device. Preliminary Report. Pekka Vuorinen. Acta radiol. **48:** 188–192, September 1957. (Department of Radiology, University of Turku, Turku, Finland)

This article describes a procedure for roentgenography with a moving narrow x-ray beam, utilizing the tube portion of any tomographic device. The object to be examined and the film are kept stationary. The narrow beam is obtained by use of a lead shield with a narrow slit perpendicular to the direction of the tube movement. The tube moves through the same arc, with the same motion and speed, as in conventional tomography. The resulting roentgenogram affords a sharp image of the part closest to the film, with a blurring of those struc-

tures that are closest to the axis of movement of the tube. The final result is very much the same as that obtained by means of conventional tomography—clear visualization of certain layers, which in this procedure are those closest to the film.

One advantage of this procedure is that only those parts in the same plane as the part to be roentgenographed are exposed, while in tomography the parts of the object other than the layer to be examined are blurred during the exposure. Another advantage is the proportionately low radiation dosage administered to the patient, approximately the same as with ordinary roentgenography of the same object.

Four roentgenograms; 2 drawings.

H. L. STEINBACH, M.D.
University of California, S. F.

Pantomography of Spherical Layers. Yrjö V. Paatero. Acta radiol. **48:** 181–187, September 1957. (Roentgen Department, Institute of Dentistry, University of Helsinki, Helsinki, Finland)

This is a technical article not suitable for abstracting. It deals with pantomograms of spherical layers. The technic involves the use of spherical films, though within certain limits quite good results were obtained with ordinary films, provided the radius of the layer was not too small and the area not too large. Ordinary flat films may be bent to correspond approximately to the limited area of the spherical layer to be examined.

Three pantomograms; 2 drawings.

H. L. STEINBACH, M.D.
University of California, S. F.

Technique for Use of Carbon Dioxide in Presacral Retroperitoneal Pneumography. Ralph R. Landes and Charles L. Ransom. Surg., Gynec. & Obst. **105:** 268–272, September 1957. (The Memorial Hospital, Danville, Va.)

Retroperitoneal pneumography is more hazardous than is commonly believed. In an earlier review (Ransom, Landes, and McLelland: J. Urol. **76:** 664, 1956. Abst. in Radiology **69:** 625, 1957) the authors reported the results of a questionnaire addressed to some 1,700 urologists, showing that in an estimated 12,000 examinations of this type there had been 58 deaths and 64 near-fatal accidents. Air, oxygen, and helium were the gases used, and all were dangerous. Though the presacral route was safer than the flank route, it was not accident-free.

The present paper deals with the use of carbon dioxide for retropneumography (see Stauffer, Durant, and Oppenheimer: Radiology **66:** 686, 1956). Due presumably to its high solubility (twenty times that of oxygen at body temperature) this gas has proved to be without serious effects in animals and man.

The authors have used carbon dioxide for retroperitoneal pneumography 18 times with no untoward effect. Because of the rapid solubility of the gas, a special method was devised of injecting it presacrally through two polyethylene tubes introduced one on each side *via* Touhy needles. When 500 to 1,000 c.c. was injected on either side, with the patient in the knee-chest position, adequate perirenal and suprarenal accumulation of gas was obtained. The technic is being refined and in 5 of the last 6 cases studied the results were satisfactory.

Two roentgenograms; 2 photographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

High Contrast: A Potential Source of Radiographic Error. G. Spiegler, R. Ollerenshaw, and R. Macey. Brit. J. Radiol. **30:** 481–488, September 1957. (Institute of Cancer Research, Royal Cancer Hospital, London, S. W. 3, England)

The authors discuss the problem of high radiographic contrast as a potential source of error. Unsharp transitions in incident radiation relief may be due to anatomical and pathological conditions and should therefore be rendered visible in the final radiograph. The harmful effect of "sharpening up" the appearance of unsharp boundaries by excessive contrast is discussed, and the somewhat fallacious link commonly taught between detail, contrast, and definition is shown to require qualification. Investigation of the lower limit of perceptible density difference under unfavorable conditions permits an estimate of optimum density range in practice. Some clinical examples are considered and the function of contrast in reproduction is pointed out.

Twenty-one roentgenograms; 7 drawings.

THEODORE E. KEATS, M.D.
University of Missouri

Red Glass X-Ray Spectacles. Erwin E. Grossmann and Paul R. Thornfeldt. Arch. Ophth. **58:** 465–467, September 1957. (E. E. G., 238 W. Wisconsin Ave., Milwaukee, Wis.)

Corning Red Glass has proved to be satisfactory for optical grinding in corrections from plano to 4–5 D., and, by a process of thermobinding, corrections up to 20 plus or minus, and bifocals or trifocals, are possible. This type of glass is particularly suited for persons using a darkroom who must wear corrective lenses. Four persons who have used such glasses have found them superior to the regulation red plastic shield worn over the glasses. One patient has worn the single vision correction for four years and is now wearing the bifocal additions.

Four illustrations.

MISCELLANEOUS

Incidence of Metastasis to Lungs and Skeleton in Breast Carcinoma and Carcinoma of the Female Genitalia. Christian-Peter Handschuhmacher and Hans-Joachim Maurer. Strahlentherapie **104:** 55–70, September 1957. (In German) (Radiation Institute of the Gynecological Department of the University of Erlangen, Erlangen, Germany)

The authors review the theories of metastasis and quote Walther on the frequency of hematogenous metastatic spread to the lungs, of cancer of the breast and of the female genitals. Venous blood from these sources drains through the venae cavae directly into the right atrium and thence into the pulmonary circulation. Transportation of tumor cells follows the same path. The lungs, therefore, represent the primary blood filter for the breast and genital organs. Further spread from the pulmonary metastases can occur through the arterial system. The capillary system of the general circulation assumes the function of a secondary filter.

Bone metastases are commonly considered by the roentgenologist to be of two types, osteoclastic and osteoplastic. The authors cite a study of 241 cases by Milch and Changus (Cancer **9:** 340, 1956). These observers could not find any histologic differences between osteoclastic and osteoplastic metastases. They therefore believe that an osteoclastic metastasis is the roent-

genological expression of progressive tumor growth, causing bone destruction. If the new bone formation stimulated in the vicinity is greater than the bone destruction, the x-ray film will demonstrate so-called osteoplastic metastasis.

On the basis of cases treated at the Gynecological Clinic of the University of Erlangen from 1947 to 1955, the authors sought to determine the frequency of pulmonary and bone metastases in cancer of the breast and female genital organs. They found pulmonary or bone metastasis or both in 10.7 per cent of the breast carcinomas but in only 1 to 3 per cent of the patients suffering from carcinomas of the cervix, fundus, ovaries, or vagina.

Three roentgenograms; 8 tables.

HERBERT POLLACK, M.D.
Chicago, Ill.

Modification (Pharmacogenic?) of Subphrenic Abscess. C. V. Cimmino. Virginia M. Monthly **84:** 444–448, September 1957. (Mary Washington Hospital, Fredericksburg, Va.)

The author believes that more and more atypical (radiologically and clinically) varieties of subphrenic inflammation are to be expected because of the early, prolonged, and widespread use of the antibiotics and chemotherapeutic agents. Attention is called to the fact that the radiologic finding of a high hemidiaphragm with reduced respiratory excursions, with pleural effusion, in the absence of primary intrathoracic disease, in a patient with clinical signs of subphrenic abscess, does not always mean that a frank accumulation of pus will be found, but rather a modified form of suppuration. This may be overlooked in the classic extraperitoneal approach for subphrenic abscess.

Three cases are presented in which there was a striking disproportion between the marked radiologic and minimal operative findings. In none of the patients was there any evidence that the radiologic picture was due to primary intrathoracic disease. It has been stated that the diagnosis of subphrenic abscess cannot be safely made unless the hemidiaphragm of the involved side is *absolutely fixed*. All 3 of the author's patients had marked reduction, but not absence, of motion of the diaphragm. Future experience will determine the reliability of this as a differential guide.

Eight roentgenograms.

Neuroblastoma: A Roentgenologic and Pathologic Study. Owings W. Kincaid, John R. Hodgson, and Malcolm B. Dockerty. Am. J. Roentgenol. **78:** 420–436, September 1957. (Mayo Clinic, Rochester, Minn.)

The authors present a study of neuroblastoma based upon 32 cases observed in a period of ten years (1945–1954).

Neuroblastomas are highly malignant tumors arising from immature neural tissue of the developing sympathetic nervous system. When small, they are well encapsulated but eventually they break through the capsule and invade neighboring structures. Approximately half of the tumors have their origin in the adrenal medulla. Neuroblastomas may, however, arise from any sympathetic nervous tissue, the most common sites of extra-adrenal origin being the retroperitoneal sympathetic ganglia in the abdomen, the pelvis, and the thorax. In adults the primary tumor is usually extra-adrenal.

The more undifferentiated neuroblastomas are locally invasive, and in only 2 of the cases reported in the authors' series could complete surgical extirpation of the primary tumor be accomplished. In 69 per cent of the cases there was clinical evidence of distant metastases at the time of admission, indicating the propensity of neuroblastomas to metastasize early and widely. There is no correlation between the size of the primary tumor and the presence or extent of metastases. The most frequent sites of secondary involvement are the skeleton, lymph nodes, liver, and meninges. The concept of Pepper and Hutchison syndromes is discarded since no pattern of selective metastasis that would fall into these categories was apparent.

Neuroblastoma is predominantly a tumor of infants and young children and is perhaps the most common malignant disease next to leukemia that occurs in this age group. The average age in the group reported was 7.8 years and the median age was 3.5 years. No racial, familial, or sexual predisposition is apparent. The presenting symptoms are usually abdominal pain, an abdominal mass, fever, debility, anorexia, and bone pain. An abdominal mass was present in 69 per cent of the authors' cases, peripheral lymphadenopathy in 41 per cent, subcutaneous metastatic nodules in 16 per cent, orbital metastasis in 1 case, and neurologic signs due to spinal cord involvement in 1 case.

The treatment of choice is complete surgical excision, but since the majority of the patients have tumors beyond the confines of surgical exenteration, a combined surgical and radiologic therapeutic approach is usually necessary. As a result of the radiosensitivity of neuroblastomas, roentgen therapy offers a reasonable chance of cure even after extension of the tumor to regional lymph nodes and to the liver. It is probable that in some cases of neuroblastoma, irradiation enhances regression to a benign ganglioneuroma.

Roentgen manifestations may be produced by the primary tumor or the metastatic lesions. When the tumor is primary in the abdomen, a mass of unit density may be demonstrated, often extending across the midline. Calcification was roentgenologically evident in 32 per cent of the primary abdominal tumors in the present series. Metastatic masses in the liver or regional lymph nodes may be visible. Excretory urography may demonstrate displacement of the kidney, usually inferiorly and laterally, and possibly deformity of the calyceal system if the kidney is invaded by the primary mass. Ureteral displacement or partial obstruction results from retroperitoneal lymph node metastasis or from primary tumors arising in the lumbar sympathetic chain. Neuroblastomas originating in the thorax present as circumscribed masses in the posterior mediastinum and may erode or displace the adjacent ribs and extend into the spinal column; the roentgen manifestations in these instances do not permit differentiation from other intrathoracic neurogenic tumors. Metastatic deposits may be seen in the mediastinal or hilar lymph nodes but pulmonary metastasis is conspicuously infrequent. Only 1 of the authors' 32 patients showed a single pulmonary metastatic lesion. Widespread skeletal metastases may occur without involvement of the lungs.

Skeletal metastases are common in neuroblastoma, 44 per cent of the cases reported in this paper showed bone involvement. Consequently skeletal surveys of the long bones, spinal column, pelvis, and skull are recommended when the diagnosis of neuroblastoma is established. A noteworthy feature of the skeletal

metastases is their bilateral symmetry. In most cases (77 per cent) the bone lesions are both osteolytic and osteoblastic; in 23 per cent of the cases, the lesions were entirely destructive. In no instance was there bone proliferation without associated destruction. In the flat bones the productive changes are more pronounced than in the long bones. Conversely, cortical destruction is seen most commonly in long bones. Soft-tissue tumor masses may be seen with cortical destruction of the long bones. Periosteal reaction is a common occurrence in metastatic neuroblastoma and was observed in 60 per cent of the cases with long bone metastases. The periosteal reaction in long bones was of the linear, parallel type in all cases but 1, in which the perpendicular or "sunburst" reaction was evident.

Metastatic neuroblastoma of the cranial vault is often characteristic in appearance, usually showing combined destruction and proliferation. In 2 cases the perpendicular "sunburst" type of periosteal reaction was observed. Associated metastases in the meninges and brain result in increased intracranial pressure which may be indicated radiographically by sutural separation. The associated features of increased intracranial pressure, "sunburst" type of periosteal reaction, and osteolytic and osteoblastic lesions of the cranial vault are virtually pathognomonic of metastatic neuroblastoma.

Occasionally pathologic fractures occur at the sites of metastases in the long bones or vertebral bodies. One of the authors' patients had a fracture of the humerus; and one of a thoracic vertebra.

Differentiation of neuroblastoma from other conditions exhibiting similar clinical manifestations must be resolved in many instances by the roentgenologist. Wilms' tumor presents the most frequent problem. Calcification within the tumor (rare in Wilms' tumor), the demonstration of a mass extrinsic to the kidney and extension beyond the midline are characteristic of neuroblastoma. Skeletal metastasis is less common in Wilms' tumor, occurs late, and is almost always purely osteolytic, while pulmonary metastasis is common and occurs early. Lymphoblastomas tend to occur in older groups than neuroblastomas, and skeletal lesions are less common and do not show the symmetrical distribution, bone production, cortical destruction, or periosteal reaction that is associated with metastatic neuroblastoma.

Skeletal involvement in leukemia is prone to be confused roentgenologically with neuroblastoma. In leukemia the bone changes are usually purely destructive and show associated transverse bands of radiolucency just beneath the epiphyses and a generalized demineralization. The periosteal reaction in the two conditions may be similar, but cortical destruction and soft-tissue tumefaction are absent in leukemia. The presence of pathologic fractures, the characteristic skull changes, and calcified abdominal tumors serve to indicate neuroblastoma.

Ewing's tumor may display features similar to neuroblastoma of bone but is usually a solitary lesion, and is uncommon in children less than ten years of age. Osteomyelitis and the reticuloendothelioses must be differentiated from neuroblastoma; lack of symmetrical involvement of multiple bones in the former and the presence of purely destructive, localized punched-out lesions in the latter are distinguishing features.

Fourteen roentgenograms; 1 photomicrograph; 1 photograph; 1 table. JOHN W. WILSON, M.D.
Johnstown, Penna.

Radiology under Blue Shield and Blue Cross in Pennsylvania. D. Alan Sampson. Pennsylvania M. J. **60:** 1199–1206, September 1957. (203 Suburban Square Bldg., Ardmore, Penna.)

There is only one Blue Shield plan in Pennsylvania, but there are five Blue Cross plans. This report was written to acquaint the radiologist of the essential features of the various plans of particular interest to him. The inadequacies of the plans and the handicaps which Blue Cross and Blue Shield face in comparison with commercial insurance carriers are discussed.

RADIOTHERAPY

Is Radium Still Needed in Cancer Therapy? Charles L. Martin. Texas State J. Med. **53:** 679–685, September 1957. (3501 Gaston Ave., Dallas, Texas)

On the basis of twenty-five years of experience the author believes that the implantation of low intensity radium sources provides the most efficient and safest radiological method available for the treatment of accessible neoplasms. The use of radon seeds is thought to be less desirable because of their possible irregular and uncorrectable distribution and the production of undesirable normal tissue damage, particularly in bone, by the emission of some beta rays. The permanent retention of seeds and their possible movement out of the tumor area may be inconvenient. Radioactive gold fragments encased in thin shells of inactive gold have also been used for interstitial therapy but have essentially the same disadvantages as radon seeds with a short half-life. Radioactive colloidal gold injected directly into malignant tumors produces some gamma rays, but most of the output is beta rays, which cause severe reactions and are absorbed by a few millimeters of tissue. The chief disadvantage of this source is the inability of the operator to obtain a uniform distribution. The injections have produced some troublesome sequelae, such as rectal ulcerations and sciatica from deposits of the radioactive material near the large nerve trunks in the pelvis.

Small rods of radioactive cobalt 60 enclosed in steel needles may be substituted for radium needles. The half-life of cobalt 60 is 5.3 years, however, and dosage calculations are constantly changing and treatment times increasing. Small fragments of cobalt 60 encased in pliable nylon threads have been useful for implantation in neoplasms growing on a curved surface such as the bladder wall. The nylon rapidly becomes brittle after repeated use, however, and it is extremely difficult to remove tiny fragments of radioactive cobalt left in a tumor when the thread is broken.

It has been shown that low intensity radium needles can be used to the greatest advantage in carcinoma of the skin, lip, tongue, alveolus, floor of the mouth, cheek, tonsil, oropharynx, metastatic cervical nodes, and uterus. They can also be used with some success in cancer of the bladder, breast, prostate, and any other lesion which can be properly implanted. Success depends on a painstaking approximation of the radioactive

sources to all of the malignant tissue, in patterns designed to eradicate all malignant cells and protect normal tissues.

Results in treating some lesions at the Martin Clinic (Dallas, Texas) are cited. In a series of 57 cases of advanced cancer of the ear, for example, treated by implantation of a layer of low intensity radium needles into the residual tumor after the involved cartilage had been removed by electrosurgery, only 9 patients were known to have died of cancer. Complete primary healing was observed in 63 per cent while 51.4 per cent had remained well for periods varying from three to seven years.

Results are also cited for cancer of the oral cavity, the tongue, and gums, for metastatic lymph nodes, and for cancer of the uterine cervix. All of these have been considered in earlier papers appearing in original or abstract form in RADIOLOGY (see, for example, **55:** 62, 1950; **60:** 147, 1953; **63:** 785, 1954; **66:** 835, 1956; **70:** 144, 1958).

Three roentgenograms, 11 photographs, 1 drawing.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Experiences with the Combination of Roentgen Rays and Mitomen in the Treatment of Advanced Malignant Neoplasms. Hellmut Schwenkenbecher. Strahlentherapie **104:** 71–81, September 1957. (In German) (Sanatorium Groedel, Terrassenstr. 2–4, Bad Nauheim, Germany)

The author reports his conclusions following the use of a combination of conventional x-ray therapy with intravenous injections of the new cytostatic drug "Mitomen" (N-Oxyd-Lost), manufactured by Asta-Werke A-G, Brackwede (Westf.). He applied this combination method to 75 patients (64 men and 11 women) suffering from advanced neoplasms. Among these were 37 bronchogenic tumors, 7 esophageal carcinomas, 12 sarcomas, and occasional lymphogranulomas, hypernephromas, and various other tumors, including one melanoma.

The daily doses of Mitomen was 50 mg. dissolved in 20 c.c. of physiologic salt solution, with a total of 700 mg. administered within fifteen to twenty days. Careful observation and control of the blood picture was considered of utmost importance. Agranulocytosis was never encountered but a temporary leukopenia was sometimes observed. This was always reversible, so that occasionally only blood transfusion and use of ACTH were necessary. Side reactions such as nausea and vomiting could be controlled with the aid of antiemetics.

The author believes that it is more advantageous to use these two forms of therapy successively than to apply them concurrently.

Because of the nature of the treated cases, a real cure was not to be expected. Quite frequently remissions of some duration, particularly disappearance of pain, and improvement of general complaints and even restoration of working ability were observed.

The palliative results of the combined treatment were better than those without Mitomen, particularly for small-cell bronchogenic carcinomas and other rapidly growing tumors.

The author recommends further testing of the method.

Five tables.

HERBERT POLLACK, M.D.
Chicago, Ill.

The Natural History of Intracranial Neoplasms, with Special Reference to the Gliomas. Harry M. Zimmerman. Am. J. Surg. **93:** 913–923, June 1957. (Montefiore Hospital, New York, N. Y.)

Tumors of the glioma group constitute approximately 45 per cent of all intracranial neoplasms. Their histiogenesis is debatable and their classification is often difficult. They are unique in that their sites of predilection in different portions of the brain are capricious and they apparently never metastasize distantly. It is assumed that a single adult glial cell is stimulated to proliferative activity and that from this cell a tumor is produced.

To account for the observation that in many gliomas there are present tumor cells of variable degrees of maturity, the theory of dedifferentiation has been invoked. Occasionally, however, one sees different types of neoplastic gliacytes in a single given tumor, such as astrocytes in an ependymoma, or spongioblasts in an oligodendroglioma. Some gliomas are mixed tumors at the start and apparently become transformed from one type to another spontaneously, or following operative intervention or radiotherapy. Almost every glioma contains, in addition to the distinctive cells from which its name is derived, a variable number of other glial elements. Classification is thus based upon the identification of the most malignant cells present and/or the predominance of one kind of cell. Upon this basis the incidence of intracranial gliomas is as follows:

Astrocytomas	25 to 29%
Astroblastomas	3 to 5%
Ependymomas	3 to 4%
Glioblastomas multiformes	26 to 48%
Medulloblastomas	10%
Oligodendrogliomas	4 to 5%
Spongioblastomas polares	2 to 4%
Unclassified gliomas	4 to 18%

It has long been recognized that, whereas the more malignant gliomas, such as the medulloblastoma, ependymoma, and glioblastoma multiforme, frequently metastasize along the cerebrospinal axis, extracranial metastasis is extremely rare. The cerebrospinal fluid may carry implants from deep-seated tumors into the ventricular cavities, or over the convexities of the brain and along the spinal canal. Occasionally gliogenous tumors develop in the scalp tissues following craniotomy, and it is assumed that these subcutaneous new growths arise from tumor cells transplanted at the time of operation. In a very few instances, malignant gliomas have been found in the lungs of patients subjected to operative procedures for brain tumor. In these cases, too, the operations would seem to be directly responsible for the metastases.

The obvious explanation for the rarity of distant metastases from intracranial gliomas is that there is no readily accessible pathway for their spread. Aside from the lack of a lymph vascular system in the brain and spinal cord, it has also been noted that the glial tumor cells have little or no ability to invade blood vessels. Gliogenous neoplasms will, however, grow extracranially with the greatest ease if mechanically transported to such locations.

In 1921, Ewing postulated the response of various types of brain tumors to radiation. By his criteria, tumors should be highly sensitive if they are richly cellular, have many undifferentiated cells, contain

numerous mitoses, are highly vascularized with delicate capillaries, and contain little intercellular substance or stroma. Were these criteria completely valid, the glioblastoma multiforme should be the most sensitive to radiation, but experience has shown that radiotherapy of this tumor has in general been disappointing. On the other hand, the medulloblastoma, which also meets Ewing's criteria for roentgen sensitivity, is very radioresponsive. Similarly, pituitary adenomas, craniopharyngiomas, and meningiomas, have frequently shown surprisingly good responses. There is also evidence to indicate that some of the less malignant gliomas, such as the ependymomas, astrocytomas, and oligodendrogliomas, have been arrested, with consequent prolongation of life. These results seem to indicate that, lacking other means of therapy in a given case, radiation therapy might be tried, with due awareness of the dangers to neural and other tissues.

Twenty photomicrographs; 1 photograph.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Technique of Radiation Treatment of Orbital Tumours. M. Lederman. Brit. J. Radiol. **30:** 469–476, September 1957. (Radiotherapy Department, Royal Marsden Hospital, London, S.W. 3, England)

The technic of treating an orbital tumor depends mainly on whether the eye is present and whether the tumor is primary or secondary. If a sound eye is present, no effort should be spared in its protection, whereas if the eye has been removed, technics can be simplified and extended in range. With a primary orbital tumor, treatment can be localized to the orbit, while with secondary invasion, particularly from the paranasal sinuses, the need to irradiate the orbit complicates treatment of the original site and imposes an additional burden upon the patient.

The author describes the technic employed at the Royal Marsden Hospital, London. Ocular protection may be obtained either directly or indirectly, depending on the degree of proptosis present and the quality of the radiation. When 220-kv radiation is to be used, a piece of lead rubber 2 mm. thick may be placed upon the closed upper lid over the part to be protected. With 2-MEV radiation, and under certain other conditions, indirect protection is necessary. This involves insertion in the beam of radiation of an absorbing material—2 mm. of lead in the case of 220-kv radiation or 7 cm. of lead in the case of 2-MEV radiation—so that the part of the eye to be protected is brought within the shadow produced by the interposed material. The author describes a special apparatus for indirect protection with a 2-MEV Van de Graaff apparatus.

Dosage for the various types of tumor is discussed and dose distributions with and without shielding are shown. Because of the necessity of shielding, a single anterior field is not adequate, and a lateral field is added.

Following removal of the eye or exenteration of the orbit, postoperative irradiation may be given by external or contact methods.

Eleven illustrations.

LUCILLE DU SAULT
The Henry Ford Hospital

Malignant Tumors of Paranasal Sinuses; Treatment and Results. W. H. Struben. Ann. Otol., Rhin. & Laryng. **66:** 754–765, September 1957. (1 Viotta St., Amsterdam, Netherlands)

This report is based upon 85 patients with cancer of the paranasal sinuses seen at the Netherlands Cancer Institute in Amsterdam between 1942 and 1955. The average time lost from the appearance of the initial symptoms to diagnosis was seven months, the shortest time being six weeks and the longest four years. There were 61 male patients with an average age of 61.5 years and 24 females with an average age of 61.6 years. Biopsy is essential to diagnosis, and complete radiologic studies, including planigraphy, are desirable to evaluate the extent of the lesion.

In this clinic all operations were done by diathermy except when the excision was known to be far outside the tumor and it was planned to close the wound or parts of it after operation.

Of the patients treated first by operation and then by radium, about 50 per cent died of cancer. This percentage was less for cases treated by x-rays followed by surgery (42 per cent) and higher for cases treated by x-rays alone (80 per cent). As regards average survival time, however, those treated by radical surgery followed by radium have the best prognosis and those receiving deep roentgen therapy followed by surgery show the poorest results. This might suggest that x-ray irradiation is a heavier burden for the patient than irradiation by radium. That fewer patients receiving preoperative roentgen therapy died from tumor may be due to the fact that they lived a much shorter time after initial treatment.

Local recurrences and metastases were seen more often after the radical operation with subsequent radium application, but this apparently is because these patients survived longer.

Most of the tumors were squamous-cell carcinoma.

Metastases of tumors of the paranasal sinuses occur in the cervical nodes and in the lung. Where cervical node metastases exist at the time of admission, the primary tumor is treated first and, as soon as there is a reasonable certainty that it is under control, a neck dissection is carried out. Preventive neck dissection is not advocated.

Three photographs, 5 tables.

JOHN P. FOTOPOULOS, M. D.
Hartford, Conn.

Malignant Lymphomas of the Pharynx. Stanton A. Friedberg, Robert H. Edwards, and George M. Hass. Ann. Otol., Rhin. & Laryng. **66:** 830–849, September 1957. (S. A. F., 122 S. Michigan Ave., Chicago, Ill.)

The presenting symptoms of malignant lymphomas of the pharynx are frequently confined to this area, but they are actually local manifestations of a systemic affliction. Only rarely does the disease remain localized; when no evidence of disease develops elsewhere, the diagnosis must be reconsidered. Reticuloendothelial reaction to infection (particularly in the pharynx) and true neoplasia are occasionally indistinguishable. It is impossible, also, to distinguish clinically between the various forms of malignant lymphoma arising in or having their primary manifestations in the pharynx.

Malignant lymphomas are quite sensitive to irradiation. Large tumors often begin to recede following a treatment with as little as 800 r and complete local dissolution may be anticipated with relatively low total dosage. Repeated irradiation and the use of neurochemotherapeutic measures for disseminated disease are effective controls for varying intervals. Eventual lack of response is to be expected, however, and occasionally the measures employed in the control of the disease may

result in undesirable tissue alterations which are responsible for a fatal outcome.

The authors previously reported 10 cases of malignant pharyngeal lymphoma (Arch. Otolaryng. **60:** 677, 1954), to which they now add 6: 3 of reticulum-cell type, 2 of lymphoblastic type, and 1 of lymphocytic type. They furnish, also, follow-up notes on 3 of the earlier patients who were alive after four and a half to six years. The combined series included 8 males and 8 females; the age range was from six to ninety-six years.

The histologic type of malignant lymphoma has no particular prognostic significance except that the giant follicular type is alleged to have the best outlook. The length of the initial period of remission seems to be the only prognostic sign of significance. In this group, the 3 patients with the longest survival time (125, 76, and 66 months) had initial remission periods of 60, 56, and 52 months, respectively. Of the 6 patients who showed signs of generalized disease soon after diagnosis by pharyngeal biopsy, none lived more than two years and some were dead in a few months.

The differential diagnosis of a nasopharyngeal mass must include various inflammatory conditions; other tumors of the pharynx, as those of the minor salivary gland type, adenocarcinomas, lympho-epithelioma, and undifferentiated carcinoma; neurofibroma of the cranial nerves, particularly when the vagus nerve is involved; chordoma, plasmacytoma and carotid body tumors.

The authors conclude that the course of malignant lymphoma varies widely from patient to patient, with some failing to respond to any type of therapy. Others may have remissions of long duration, with protraction of the disease up to twenty-five years before a final relapse causes death. Current therapy, if carried out vigorously, may eliminate all microscopic evidence of the disease, but unfortunately "the locus and amount of therapy required to do this under present conditions is sooner or later lethal to the patient."

Five photographs, 1 table.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Experiences in the Treatment of Malignant Tumors of the Epipharynx, Tongue, and Tonsils, Based on Admissions to the Heidelberg University Ear, Nose and Throat Clinic in the Past Ten Years. Werner Schwab, Werner Ey, Karl Werner, and Kurt Ernst Scheer. Strahlentherapie **104:** 36–50, September 1957. (In German) (The Ear, Nose, and Throat Clinic, University of Heidelberg, Germany)

The authors report on their experience with the combined surgical and radiological treatment of malignant tumors of the epipharynx, tongue, and tonsil, during the ten years from 1945 to 1955. They explain the various surgical technics used for the primary tumor and regional lymph nodes in detail and also the types of concurrent radiation therapy.

A rigid therapeutic regime could not be established because of the differences in location and extension of the tumors. The procedures described can serve only by way of a guide-line for surgical and radiological management.

The evaluated material consisted of 96 epipharyngeal, 88 lingual, and 79 tonsillar tumors, which the authors considered too small a number to warrant statistical analysis. They stress the importance of mutual co-operation in the selection and application of the various surgical and radiological measures and close contact between these two specialties.

Twelve figures, including 1 roentgenogram.

HERBERT POLLACK, M.D.
Chicago, Ill.

Necropsy Studies in 16 Cases of Bronchogenic Cancer Treated by 2 Million Volt Roentgen Ray. Ching Wu. J. Philippine M. A. **33:** 643–659, September 1957. (National Health Administration, Taipei, China)

This paper is based upon 16 cases of bronchogenic cancer treated from 1953 to 1956 at the Los Angeles Tumor Institute, with subsequent necropsy. In the majority, opposing anterior and posterior ports were used, to include the mediastinum, the affected portion of the lung, and the infra- and supraclavicular regions. The field sizes varied from 17 × 16 cm. to 32 × 25 cm. Total tumor doses from 5,000 to 6,000 r were delivered in 11 cases. Treatment time was from sixteen to seventy-eight days, an average of seven weeks. The daily equilibrium dose was between 200 and 325 r. Physical factors were: 2,000 kv, distance 125 cm., filtration 7 mm. lead, h.v.l. 12.5 mm. copper. It has been found that this technic usually affords relief of symptoms, with a more adequate and uniform dose to the primary lesion and to most of the adjacent lymph nodes. Between 7,500 and 8,000 r could be delivered, if necessary.

Roentgenograms of the chest were most helpful in making a preliminary diagnosis of neoplasm, in defining the extent of local node involvement, and in determining the degree of response to irradiation. Ten patients showed definite roentgen evidence of improvement or disappearance of the primary tumor. In 12 patients radiation fibrosis was demonstrable, and 2 showed evidence of radiation pneumonitis.

Death was due to metastatic growth in 14 cases, pneumonia in 1 and to coronary thrombosis in 1. The response of the tumor to radiation was proved at necropsy in many of the cases. In 5 there was marked reduction of the enlarged lymph nodes. Survival time was as long as seven and a half months after completion of the course of radiation therapy. The best response to radiation was obtained in patients with epidermoid-cell cancer.

No definite evidence of damage to the normal lung tissue was found at necropsy in any of the patients who received a tumor dose of 5,000 or 6,000 r.

The author feels that for inoperable bronchogenic carcinoma treatment with 2-million volt roentgen rays is the method of choice.

Sixteen roentgenograms, eight tables.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Preclinical Carcinoma of the Cervix. J. P. A. Latour, L. B. Brown, and L. A. Turnbull. Am. J. Obst. & Gynec. **74:** 354–360, August 1957. (Royal Victoria Hospital, Montreal, P. Q., Canada)

At the Royal Victoria Hospital, Montreal, 154 cases of preclinical cancer of the cervix were diagnosed between Jan. 1, 1947, and Dec. 30, 1955, by ring biopsy with endocervical curettage and step-sectioning of serial blocks of the biopsy. These cases were discovered in the routine cytological screening of clinically negative cervices. Approximately one-half of the cervical cancers diagnosed in the total of 8,274 routine cytological screenings in 1955 were in the preclinical stage. Of the

154 cases seen in the nine-year period, 57 were classified as carcinoma *in situ*, 97 as "early invasive."

Of the patients with carcinoma *in situ*, all remained well at the time of the report. Only 1 patient of 17 who received no further treatment than that incidental to ring biopsy or conization plus endocervical curettage had recurrence of positive cytology, and that was three years later; 4 patients in this group had subsequent pregnancies. Only 3 of the 97 patients with "early invasive" cancer received no further treatment; none of this group had recurrences and 40 had been observed five years or more.

The dangers of overtreatment appeared to be more serious than the theoretical risk of conservative methods. Total hysterectomy with removal of the vaginal cuff, and with preservation of the ovaries, seemed to be adequate treatment for both carcinoma *in situ* and "early invasive" carcinoma of the cervix. However, various methods of treatment were employed. Irradiation, usually with radium, was used alone in two-thirds of the "early invasive" group; less frequently, it was combined with hysterectomy or hysterectomy with bilateral salpingo-oophorectomy. Two patients had a severe radiation necrosis necessitating abdominoperineal resection, though they had received only 3,000 mg.-hr. of radium to the cervix. The surgical treatment most frequently used was hysterectomy alone or combined with salpingo-oophorectomy. In 2 of 3 patients treated by Wertheim hysterectomy, ureteral fistulas developed, necessitating nephrectomy.

Three patients with carcinoma *in situ* were treated by radium; as noted above, 17 had no further treatment; in 37 hysterectomy was done alone or combined with bilateral salpingo-oophorectomy.

With the lack of evidence of recurrence in this group to date, the authors have been encouraged to attempt to determine the minimal effective treatment for preclinical carcinoma of the cervix. A conservative approach is advocated in young women with carcinoma *in situ* who are desirous of further pregnancies and fully understand the implications. Such a policy is not advocated at present in the "early invasive" group.

Cases of "early invasive" carcinoma of the cervix should be separated, identified, and treated as a separate category from International State 0 and Stage I.

Three photomicrographs; 1 graph; 3 tables.

ROBERT L. EGAN, M.D.
University of Texas, Houston

Can the Cure Rate of Squamous Cell Carcinoma of the Uterine Cervix Be Improved? Gilbert H. Fletcher. Texas State J. Med. **53:** 698–701, September 1957. (M. D. Anderson Hospital and Tumor Institute, Texas Medical Center, Houston 25, Texas)

At the M. D. Anderson Hospital, an individualized radium and external irradiation technic has led to cure rates of better than 80 per cent in Stage I cases of carcinoma of the cervix, and better than 60 per cent in Stage II cases. About 80 per cent of the group suitable for radical hysterectomy are salvaged. This is fully as good as the results obtained by radical hysterectomy and lymphadenectomy.

In Stages I and II the disease on and around the cervix is almost always controlled; about 50 per cent of the patients who died had either distant metastases or intercurrent disease. Thus, a different approach to the treatment of the primary lesion is not warranted. A more radical treatment of the pelvic wall disease can salvage only a small additional fraction, as intercurrent disease and distant metastases, already seeded at the time the patient is first seen, are beyond control.

In view of the favorable results cited above, it is felt that different or more radical radiation therapy to the parametria and the pelvic walls would be unwise in Stage I and early Stage II disease unless there is no appreciable risk of major or minor complications. This excludes high doses to the whole pelvis and leaves only intraparametrial injection of colloidal gold as a potential means of sterilizing tumor cells in the lymphatics and the lymph nodes (see Allen, Sherman, and Arneson: Am. J. Obst. & Gynec. **70:** 786, 1955. Abst. in Radiology **67:** 313, 1956)

Results in late Stage II cases are less favorable, and the cause of failure is often enough due to uncontrolled pelvic disease to warrant a more radical approach. Poorer results in the Stage III cases, with greater incidence of uncontrolled pelvic disease, justify a treatment based on the assumption that pelvic dissemination is present when the patient is first seen. As yet there is no indication that the salvage rate is better with an extended Wertheim operation than with conventional technics of radium and external irradiation. Studies at the Radiumhemmet (Acta radiol. **42:** 237, 1954) have shown that the uterine radium is the largest contributor to pelvic wall node areas as well as the lateral parametria. Changes in radium technic to the extent of using the uterine tandem alone in more advanced cases offer the possibility of irradiating the entire pelvis more thoroughly and have resulted in increased cure rates in all stages.

The effectiveness of supervoltage roentgen therapy cannot yet be evaluated. The author is using the betatron for high dosage to the entire pelvis with additional local therapy either by radium or transvaginal cone. In order to determine the effectiveness of such treatment, lymphadenectomies have been performed in 100 consecutive Stage III cases three months after the completion of irradiation. Less than 20 per cent of the pelvic wall nodes were found positive for squamous-cell carcinoma. This figure is much lower than would be expected in unirradiated Stage III cases. Complications do occur, however, with such radical therapy, and adjustments in dose levels must be made.

In Stage IV cases the disease is so massive that, no matter how radical the treatment, very little can be expected. Radical radiation therapy may be more damaging than beneficial. On the other hand, it may contribute to relief of excruciating pain associated with nerve involvement and bilateral ureteral obstructions.

In summary the author believes that in the Stage I and early Stage II cases a more radical attack to increase an already propitious survival rate should be thought out very conservatively and is warranted only if no complications result. The problem is different in the more advanced cases, for which more radical radiation therapy, alone or combined with surgery, is justifiable even if the incidence of complications is increased.

One chart; 6 tables.

JOHN P. FOTOPOULOS, M.D.
Hartford, Conn.

Treatment of Carcinoma of the Vulva at the University of Würzburg Gynecological Clinic from 1947 to 1951. Alfons Rummel. Strahlentherapie **104:** 51–54, September 1957. (In German) (Würzburg, Germany)

Although vulvar carcinoma comprises only a relatively small percentage of the malignant tumors of the

genital tract, it represents a rather difficult and important problem because of the various methods of treatment. The type of therapy depends on the extension of the tumor, the involvement of the lymph nodes, and the patient's age. In the author's series of 21 cases, about 50 per cent of the palpable inguinal nodes proved to be of inflammatory nature, showing no evidence of malignancy.

A grouping into stages similar to that of cervix carcinoma was employed:

Group 1. All beginning carcinomas up to 2 cm. in diameter, with the tumor freely movable. No involvement of inguinal nodes.

Group 2. Tumor larger than 2 cm. in diameter, with more local destruction, but no inguinal node involvement.

Group 3. Extension as in Stage 2 but with involvement of the inguinal nodes, which still can be removed surgically.

Group 4. All advanced carcinomas with invasion of the vagina, perineum, rectum, and urinary bladder, associated with infiltration of the inguinal nodes and exhibiting distant metastasis.

Fifty per cent of the author's patients belonged to Groups 1 and 2 and were treated with partial vulvectomy, followed by a radium mold to the wound bed, but without subsequent x-ray irradiation of the inguinal areas. Eight of the 10 patients representing Groups 1 and 2, treated with these methods, were considered cured.

In Group 3, numbering 11 cases, total vulvectomy was performed, with excision of the inguinal and femoral nodes, if they still were freely movable. Postoperative x-ray irradiation and the radium mold were used routinely, but no five-year cure was obtained.

The absolute cure rate for the entire series was 38.1 per cent.

One table.

HERBERT POLLACK, M.D.
Chicago, Ill.

Roentgen Therapy of Osteogenic Sarcoma. A. Zuppinger and H. R. Renfer. Radiol. clin. **26:** 312–318, September 1957. (In German) (Röntgen Institute of the University of Bern, Switzerland)

Osteogenic sarcoma is ordinarily considered a surgical rather than a radiological problem. According to the authors, this conception needs revision. Long-term survival rates in unselected material run about 5 per cent with the customary surgical management. A series is reported here consisting of 9 patients who were considered inoperable, who refused amputation, or upon whom the surgeon decided not to do a mutilating procedure because of the small chance of success. The histologic diagnosis in all cases was verified. Treatment was solely by irradiation. Five of the 9 patients have been free of symptoms of tumor from ten months to eight years. The 4 dead with lung metastases showed no sign of local recurrence. Two cases with five-year survival are reported in detail.

Effective irradiation requires high dosage applied in four to six weeks. With conventional deep therapy this has been attempted with three sittings a day. Use of supervoltage technics simplifies treatment. Conventional irradiation has the further disadvantage that bone necrosis is avoidable only with highly radiosensitive tumors.

On the basis of their experience, and considering the fact that amputation in these young patients offers small chance of cure, the authors feel that radiotherapy, preferably with the higher voltages, should be the treatment of choice for osteogenic sarcoma. If the tumor does not disappear completely under such treatment, surgery can be undertaken later. In this way, many unnecessary mutilating procedures that do not cure will be avoided.

Six roentgenograms; 2 photomicrographs; 1 table.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Radiation Therapy in Vernal Conjunctivitis. Bertil Ebenius, Sven Larsson, Ebbe Cederquist, and John Cristiansson. Acta radiol. **48:** 193–204, September 1957. (Department of Radiotherapy, University Hospital of Lund, Sweden)

Radiotherapy appears drastic treatment for vernal conjunctivitis but in severe cases with marked hyperplasia, ptosis, etc., intractable to simpler methods, radiation justifies its long use in this field. The authors analyze their results in 11 patients, 9 of whom had bilateral involvement, with a total of 20 treated eyes.

Four eyes with tarsal changes were treated with radon. In 2 of these, where the dose was calculated at 2,500 rep (roentgen equivalent, physical) administration by spray technic over a period of forty-one days proved unsatisfactory and contact roentgen therapy was substituted. In the other 2 eyes a total of 16,500 rep was delivered to each of three fields in 77 days in one eye and in 105 days in the other. Two eyes with limbus lesions were treated with radon: in one, 5,000 rep was delivered to each of two fields at a single sitting; in the other from 13,000 to 22,000 rep to each of four fields in from 70 to 190 days. In none of these cases was there objective evidence of vernal lesions two to eleven years after therapy, although some patients had residual slight itching and a feeling as of a foreign body. All showed telangiectases or atrophy of the treated areas. In 1 of the limbal cases peripheral lenticular opacities developed that did not interfere with vision.

All of the remaining tarsal lesions were treated by contact roentgen therapy: 16 eyes were treated with a dose of 1,000 r given every second week up to a total of 4,000 to 6,000 r. If healing did not ensue, a further dose of 1,000 r was given once or twice after two or more months. An applicator, 20 to 25 mm. in diameter, was used on the everted lid, sparing the eyelashes; the globe was protected by a lead shield. The factors were: 50 kv; 2 ma; added filtration of 0.2 mm. Al; F.S.D. 18 to 38 mm.; h.v.l. 0.32 mm. of Al. Half of the patients thus treated still had slight itching, or photophobia, or a foreign body sensation, but of the vernal lesions only 2 still had a slight discharge. Most of the patients had mild to moderate atrophy and telangiectasis, which appeared within a year and were noted up to five years after treatment.

The authors feel that, with their new apparatus of low intensity, 10 to 15 kv, with a beryllium window, the risk of injury to the lens will be minimized, since the falloff in the depth dose is more marked than with strontium 90. Fractionation over relatively long periods of time allows for relatively safer administration of a curative dose in addition to minimizing radiation reactions in these symptomatic patients.

Ten colored photographs; 2 depth dose curves; 3 tables.

SAUL SCHEFF, M.D.
Boston, Mass.

Exophthalmos and Radiotherapy. Ed. Rosselet and P.-J. Rosselet. Radiol. clin. **26:** 250–253, September 1957. (In French) (Institut universitaire de radiologie, Lausanne, Switzerland)

The authors do not discuss exophthalmos due to orbital cancer or endocrine dysfunction, but a special variety whose clinical features suggest a new growth and whose evolution, surgical exploration, and histologic examination all indicate an inflammatory basis. This condition is usually described as "inflammatory pseudotumor." There are three groups according to Birch-Hirschfeld, who first described this entity in 1905. The first group presents as an orbital tumor, but often shows spontaneous regression; the etiology is undetermined. The second group is a chronic inflammation, and the third group is characterized by inflammatory changes in the vascular walls and plasmocytic infiltration. Other authors have considered the lacrimal gland as the source of inflammation, and in 2 cases tuberculosis was found.

Another variety of pseudotumoral exophthalmos is due to a chronic orbital myositis, pure or associated with a diffuse orbital cellulitis. Histologic examination in this group shows an enormous infiltration of the ocular muscles, consisting of lymphocytic follicles with interfascicular edema, interstitial fibrosis, and muscular degeneration. This variety is very similar to the malignant exophthalmos of hyperthyroidism.

The clinical course in pseudotumoral exophthalmos often leads the physician to perform enucleation, because of fears of malignancy. The authors feel that a trial of radiotherapy is indicated in such patients. They report 2 cases in which x-ray therapy gave excellent results. They comment that, in this "super-antibiotic age," it is good to recall the therapeutic action of the roentgen rays. CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Combined Therapy for Peyronie's Disease. E. H. Burford and C. E. Burford. J. Urol. **78:** 265–268, September 1957. (958 Arcade Bldg., St. Louis 1, Mo.)

The authors review the results of various modalities of treatment of 186 fibrotic lesions of the penis known as Peyronie's disease. The gray, glistening, scar-like areas measure 3 to 5 mm. in thickness, are rather striated and nodular. They often resemble keloids and frequently contain calcium deposits; they have been known to contain cartilage and even bone. Microscopic examination shows no inflammatory process but rather a few vessels, many spindle cells, and abundant compact bundles of connective tissue with no evidence of malignancy. Clinically, aberration in erection is the chief complaint, with pain in only 20 per cent of the cases.

Tabulation of the results of therapy shows that the best results (84 per cent of 31 cases cured or improved) were obtained with a combination of radium plaque and mixed tocopherols. A 50 mg. capsule of Tocopherex (Squibb) was given orally every day for thirty to sixty days. The radium plaque consisted of the desirable number of 12.5-mg. radium element needles arranged in parallel, separated from one another by 1/4 inch and screened by 1 mm. of lead, the entire construction being held together by 1 mm. of gum rubber. The number of needles per plaque and the number of plaques used depended on the size, site, and shape of the Peyronie nodules. The total dosage in milligram-hours of exposure to the radium plaque varied from 50 to 400, but the latter amount covered more than one location. A single treatment averaged 120 mg. hours. With the use of the radium plaque alone (96 cases) the cure rate was 77 per cent.

One photomicrograph; 3 tables.
SAUL SCHEFF, M.D.
Boston, Mass.

Some Measured Rotation Distributions for 250 kV Therapy. Margaret T. Morrison, H. Bean, and Norma Kewley. Brit. J. Radiol. **30:** 461–468, September 1957. (H. B., Allan Blair Memorial Clinic, Regina, Saskatchewan, Canada)

With a 10-cu. mm. condenser chamber and a Lindemann electrometer, complete dose distributions were determined for the following situations: (*a*) 300° rotation, missing a 60° sector opposite the vertebrae; (*b*) 220° rotation about two axes; (*c*) "split rotation." Measurements were made in oval phantoms of tissue-equivalent wax for field widths of 4, 6, 8, and 10 cm. and 3 sizes of ovals. Isodose curves are shown for various situations. The material is summarized in a table, and it is suggested that the dose at the axis of rotation be determined by the use of tumor-air ratios and that doses at other points be obtained by interpolation from values given in the table.

Seven figures; 3 tables. LUCILLE DU SAULT
The Henry Ford Hospital

Idealized Body Contours in Rotation Dosimetry. Robert H. Haynes and Gerd Froese. Acta radiol. **48:** 209–226, September 1957. (Ontario Cancer Foundation, London Clinic, London, Ontario, Canada)

Since it is well established that in 360° rotation therapy the use of the central tumor dose is a practical clinical measure, the authors have developed a rapid method for arriving at this dose which requires only measurements of the anteroposterior and lateral thicknesses of the patient. The procedure is in essence an extension of that of Johns (see Johns *et al.*: Am. J. Roentgenol. **75:** 1105, 1956. Abst. in Radiology **68:** 631, 1957) and gives essentially similar values.

The tumor-air ratio function $R_{(r)}$ is difficult to appraise accurately in either method, since both are subject to the errors inherent in the use of water phantoms. Nevertheless, the averaged tumor-air ratio with Co^{60} teletherapy can be calculated by substituting for the patient's body cross section in the treatment plane a suitable idealized body contour and then integrating the tumor-air ratio around this contour. The water-equivalent tumor-air ratio for 360° may then be calculated.

The resulting integrals for three field sizes as a function of the contour parameters have been evaluated. These integrals are valid only for central tumors, but with a correction factor presented in the paper eccentric tumors may also be treated. In the majority of rotation cases this latter factor is so small as to make it negligible. The method may be extended to roentgen ray rotation and sector rotation therapy.

The formula and its derivation along with explanatory notes should be familiar to all engaged in 360° rotation therapy with radioisotopes or medium range x-rays.

Thirteen diagrams, 1 table. SAUL SCHEFF, M.D.
Boston, Mass.

Measurement Results in Radiotherapy Applied Through a Plaster Bandage. E. Kahr. Fortschr. a. d. Geb. d. Röntgenstrahlen **87:** 344–347, September 1957. (In German) (Central X-Ray Institute of the State Hospital, Graz, Austria)

In pathological fractures due to tumor, two basic principles of treatment must be observed. The fracture, after proper reduction, must be firmly immobilized and proper x-ray therapy must be instituted.

The author has been making careful measurements on a phantom in order to determine the depth dose delivered by an x-ray beam after traversing plaster-of-Paris bandages of 5, 10, and 15 mm. thickness. The irradiation factors were 200 kv, 20 ma, distance 40 cm. The field size was 10 × 15 cm. Measurements were made through a filter of 0.5 mm. Cu (output, 86 r per minute) and 1 mm. Cu (output, 60 r per minute). Half-value layers are not given. Tables and graphs show in detail the results of the measurements.

For practical purposes one may say that the attenuation of the x-ray beam filtered through 1 mm. Cu amounts to about 5 to 10 per cent with 5 mm. plaster of Paris; 10 to 20 per cent for 10 mm. plaster of Paris; 20 to 25 per cent with 15 mm. plaster of Paris. With 0.5 mm. Cu filtration the attenuation is a little higher. No involvement of the skin need be feared from any secondary irradiation from the cast.

Two graphs; 2 tables.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Small Probe Dosimeters. L. G. Stephens-Newsham and J. La Palme. J. Canad. A. Radiologists **8:** 60–62, September 1957. (Montreal, Quebec, Canada)

Small probe dosimeters find application in situations where small fields are to be measured, where there may be sharp variations in intensity of radiation, as under treatment grids, and with radium applicators where there may be marked variations in dose rate between points a millimeter apart. Ionization chambers may be used for this purpose and have the advantage of being made air-equivalent more easily, but the design of very small chambers presents problems of high insulation and amplification of small currents.

As an alternative to ion chamber dosimeters, two other principles of radiation measurement have been investigated and applied by the authors to the development of small probe dosimeters. The one depends upon the fluorescence of certain crystals and the other upon the conductivity of cadmium sulfide under radiation.

The fluorescence, or scintillation, probe dosimeter was constructed to be sensitive, stable, and rapid in response. Crystals of calcium tungstate, and anthracene were used, being 5 mm. in diameter and 5 mm. in length. The crystal was mounted at the end of a "light piper," a hollow tube of Lucite, through which the light from the crystal is conducted to a photomultiplier tube of an end-window type and tube current is measured. Anthracene was found to be almost as sensitive as calcium tungstate and free of lag after termination of exposure.

The use of a semiconductor, cadmium sulfide, was investigated. Cadmium sulfide crystals are quite small, about 2 mm. in diameter and 3 or 4 mm. long. Relatively large currents flow and can be easily measured. Probes so designed may be placed in long flexible tubes, a meter or so in length, for intracavitary measurements, *e.g.*, in the esophagus. The crystals ordinarily have a high resistance of several megohms but under exposure to light or x-ray this drops sharply. To get a robust portable indicator for currents of less than a microampere a simple transistor bridge circuit was developed. A complete energy dependence curve has not been plotted, but preliminary measurements indicate a wide variation.

Two diagrams; 2 graphs.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Intravenous Infusion of Bone Marrow in Patients Receiving Radiation and Chemotherapy. E. Donnall Thomas, Harry L. Lochte, Jr., Wan Ching Lu, and Joseph W. Ferrebee. New England J. Med. 257: 491–496, Sept. 12, 1957. (E. D. T., Mary Imogene Bassett Hospital, Cooperstown, N. Y.)

Experiences and observations in the collection, storage, and usage of human bone marrow are reported. Utilizable bone marrow material may be obtained from biopsies of the ilium; from surgical specimens, usually ribs; and from fetal and adult cadavers under certain controlled conditions. The marrow material is prepared by repeated passage through a special steel screen. The fat is removed by centrifugation and the cells are resuspended in tissue-culture fluid and serum for injection or storage in glycerol at −80 degrees C. for later administration.

Six cases are reported indicating that the marrow preparations may be given intravenously to man without adverse early or late reactions.

The authors speculate on possible future uses for marrow grafts, mentioning specifically patients with leukemia needing radiation but having insufficient marrow reserves. Extensive marrow damage resulting from toxic drugs or other agents may conceivably be salvaged by the use of marrow transplants. An interesting possible application lies in the treatment of radiation casualties from atomic reactor explosions or acts of war.

Three graphs; 1 table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

RADIOISOTOPES

Clinical Applications of Radioactive Isotopes. John D. Reeves. New England J. Med. **257:** 454–461, Sept. 5, 1957; 507–513, Sept. 12, 1957; 559–566, Sept. 19, 1957; 605–612, Sept. 26, 1957. (Massachusetts General Hospital, Boston 14, Mass.)

This article, published in four parts, is a review of the entire field of medical usage of radioactive isotopes. Virtually all of the isotopes which have any application to physiologic, diagnostic, or therapeutic problems are commented upon. General principles governing the uses of radioactive isotopes in man are reviewed, and in some cases physical aspects are noted. In many instances general dosage ranges and fundamentals of technical applications are stated. How-

ever, the author does not discuss technical details of procedure or dosage.

The paper is judged to be of value to those desiring an overall familiarity with the field of medical radioisotopes, and is good source material for that purpose. Those dealing directly with isotope procedures will not find much utilizable material in this communication because of its general nature.

The attached extensive and detailed bibliography allows a broad coverage of the entire field of radioisotopes.

Twelve diagrams, 1 table.

JAMES W. BARBER, M.D.
Cheyenne, Wyo.

Isotope Localization in Brain Tumors. William T. Peyton. Am. J. Surg. **93:** 952–955, June 1957. (412 Delaware St., S.E., Minneapolis 14, Minn.)

There is a greater uptake of intravenously injected sodium diiodofluorescein in many brain tumors than in normal brain tissue. With a Geiger-Müller tube attempts were made to localize brain tumors by finding the difference in counts in symmetric positions on either side of the head; a difference of 10 per cent or more was considered to be significant if it persisted on recounting.

Asymmetry may be focal or diffuse and is to some extent correlated with the underlying pathologic condition of the brain. Focal asymmetry usually gives a 10 per cent difference in more than one adjacent position with little or no asymmetry in the surrounding areas. It is prone to occur over a superficial lesion without edema in the surrounding tissues. Diffuse asymmetry gives a 10 per cent difference often in only one area but with a decreasing difference in the other positions on the same side so that the exact margin of the asymmetry is difficult to define. This diffuse asymmetry is prone to occur when the lesion is deep or is surrounded by edematous brain tissue.

Radioactive iodinated serum albumin (RIHSA) has been found to give a sustained and therefore stable blood and tissue level for as long as twenty-four hours after injection. Therefore it has come to be the tracer material of choice for isotope encephalometry. Diiodofluorescein (DIF), on the other hand, shows a 50 per cent drop from the initial level one hour after intravenous injection. The only disadvantage of RIHSA is that it is gradually metabolized, liberating free I^{131}, which is taken up by the thyroid unless the gland is previously blocked by the administration of stable iodine.

The earlier technic, using the Geiger-Müller tube and DIF, was successful in localizing 17 out of 26 tumors found in 57 cases. In another group, of 46 cases in which the scintillation counter and RIHSA were used, all 17 tumors later known to be present were actually localized.

Midline lesions cannot be detected by asymmetrical counts, and cystic lesions take up less radioactive material than normal brain and may give a false diagnosis. For such cases a graphic method of analysis has been developed. A standard curve of radioactivity was obtained from counts made in twelve positions on either side of the head following radioactive injections in 27 persons believed to be normal. This serves as a basis of comparison for cases of suspected disease.

Evaluating the accuracy of isotope localization as a diagnostic procedure for brain lesions, the author states that, "if a positive focus is found, it is quite certain that the patient has a tumor, abscess, hematoma, or other gross cerebral lesion. A negative finding, *i.e.*, no focus demonstrated, is far less reliable. If utilized with the clinical data, isotope encephalometry is quite accurate and useful in selecting doubtful cases for additional study by air injection or angiography."

One chart. ALFRED O. MILLER, M.D.
Louisville, Ky.

The Radioiodine Profile in the Diagnosis of Thyroid Disease. Sidney Rubenfeld, S. Steven Brodie, Nathan Mitchell, Martin Lowenthal, and Anthony Kohn. Arch. Int. Med. **100:** 266–271, August 1957. (S. R., 755 Park Ave., New York 21, N. Y.)

The twenty-four-hour uptake of I^{131} by the thyroid does not always reflect the true clinical picture of thyroid disease. Additional tests have therefore been introduced to clarify the discrepancies. This presentation correlates the twenty-four-hour I^{131} uptake, salivary tests, and conversion ratios with the clinical status in 164 patients classified as euthyroid, hyperthyroid, or hypothyroid on the basis of the history, physical examination, and other laboratory procedures. The most reliable single index of thyroid function was found to be the conversion ratio. Next in order were salivary activity and the twenty-four-hour uptake. The sum total of all three tests, a "thyroid profile," is of greater accuracy than any one test alone.

Three charts; 6 tables.

The Salivary Secretion of Iodide in Hypothyroidism. Marion H. Ferguson, A. Naimark, and J. A. Hildes. Canad. M. A. J. **77:** 578–581, Sept. 15, 1957. (University of Manitoba, Winnipeg, Manitoba, Canada)

The ability of the salivary glands to concentrate and secrete iodide was studied in 12 euthyroid and 5 hypothyroid individuals. In some tests, mixed saliva from the submaxillary and sublingual glands was used, and in others parotid secretion only.

The euthyroids, 6 males and 6 females, ranged in age from twenty-five to sixty years; this group was made up of healthy laboratory workers and patients convalescing from diseases not related to the salivary or thyroid glands or the kidney. The hypothyroid patients ranged in age from thirty-six to sixty-five years; the basal metabolism rates were −17, −19, −26, −37, and −36, and the twenty-four-hour uptake of I^{131} was 5, 2, 9, 4, and 7 per cent of the administered dose. No difference was found in the secretion of iodide by the parotid glands of these two groups of patients.

Experiments in which parotid juice was compared with simultaneously collected saliva from the submaxillary and sublingual glands indicated large and inconsistent differences between these two sources of saliva.

Four charts; 2 tables.

Radioactive Sodium Chromate and the Measurement of Red Cell and Plasma Volume in Man. Raymond C. Read and Sigrid Gilbertsen. Arch. Int. Med. **100:** 259–262, August 1957. (University of Minnesota Medical School, Minneapolis 14, Minn.)

One hundred red cell volume determinations were carried out in 86 patients on the medical and surgical wards of the University of Minnesota Hospitals, with radioactive chromium. The method employed was basically the same as previously described (New England J. Med. **250:** 1021, 1954). The plasma volume

was estimated in each instance on the assumption that ascorbic acid-treated sodium chromate labels plasma proteins.

The relationship between the peripheral hematocrit and the total-body hematocrit was determined. A comparison of these values with the results of previously reported studies in which the red cell volumes were obtained with Cr^{51} and plasma volumes with Evans blue dye indicates that the excess sodium not taken up by the red cells when treated with ascorbic acid cannot be used to measure plasma volume. It would seem that for satisfactory labeling of plasma proteins with reduced sodium chromate it will be necessary to use an alternative reducing agent which does not itself bind chromic ion.

Four graphs.

RADIATION EFFECTS—PROTECTION

Pre-Existing Roentgen-Ray Dermatitis in Patients with Skin Cancer. Robert S. Totten, Philip G. Antypas, S. Milton Dupertuis, John C. Gaisford, and William L. White. Cancer **10:** 1024–1030, September-October 1957. (R. S. T., University of Pittsburgh School of Medicine, Pittsburgh, Penna.)

The records of 105 patients with skin cancer admitted consecutively to the Presbyterian, Woman's, and Eye and Ear Hospitals (Pittsburgh), from July 1950 through June 1955, were reviewed. The group included 84 patients with basal-cell carcinoma and 21 with squamous-cell carcinoma. Information concerning previous roentgen therapy was obtained from the admission histories, and no special questionnaire was employed.

Of the 105 patients with skin cancer, 20 gave a history of roentgen exposure, from fourteen to forty-five years previously. All but 1 had definite clinical evidence of chronic radiodermatitis. Ten patients with basal-carcinomas of the face, neck, or shoulders had been treated for acne. Three physicians whose hands were exposed during repeated fluoroscopic examinations had squamous-cell carcinoma. The remaining 7 patients had received radiotherapy for a variety of benign conditions; in 3, squamous-cell tumors were present, in 4, basal-cell carcinomas located on the face, neck, trunk, or extremities. Of interest were the low mean ages of the acne-irradiated groups, 46.6 years for the men and 43.8 years for the women. Eight patients had received some form of definitive treatment (roentgen therapy, electrocautery, or surgery) for tumor prior to their last admission.

Clinically the basal-cell carcinomas were generally encountered in three forms. The most common was an ulcer crater with raised, rolled margins. Next in frequency were small scaly patches sometimes not considered significant clinically but proving to be cancerous on histologic examination. The third type was seen in only 2 patients and consisted of a focal induration of the upper lip and nose with slight puckering of the overlying epidermis, with no ulceration.

All patients were treated surgically. The operations varied from simple excision with primary closure to extensive resection with large free skin grafts or some type of flap coverage. In 8 patients with extensive radiodermatitis, wide excision and resurfacing procedures were done. Amputation of an extremity was necessary in 4 patients.

The ultimate prognosis for patients with skin cancer associated with radiodermatitis is probably worse than that for nonirradiated patients with similar tumors because of the high recurrence rate and the tendency for multiple tumors to develop (in 9 of the 20 patients). It is possible that the occurrence of extensive tumors can be reduced by careful periodic examinations, early treatment of suspicious lesions, and prophylactic removal of areas of radiodermatitis.

Two photographs; 7 photomicrographs; 4 tables.

Dose to the Gonads During Diagnostic Procedures. F. D. Sowby. J. Canad. A. Radiologists **8:** 57–59, September 1957. (86 Elgin St., Ottawa 4, Ontario, Canada)

For any population the genetic effects of radiation are directly related to the gonadal dose to that population. On an average, the dose received from natural background is 100 millirem per year. The greatest amount of man-made radiation comes from diagnostic radiology. This is estimated as at least 22 millirem per year, and may, over the reproductive span, be many times that of background.

Examinations in the region of the pelvis are responsible for most of the dose received from diagnostic radiology. The male is especially vulnerable. Several steps may be taken to keep such dosage to a minimum.

1. Examinations should be restricted to those which will give essential information. Technical errors must be avoided so that repeat examinations need not be done.
2. Strict indications must be present for examinations about the pelvis, especially in pregnant women.
3. Routine fluoroscopy should be avoided.
4. Technical measures should be employed to insure that dosage is minimum for the examination to be done, *e.g.* limiting diaphragms, filtration, etc.
5. Gonads should be shielded when practicable.
6. Those who employ roentgen apparatus should know their equipment, its output under various circumstances, and how to keep this output to a minimum.

Two tables. JOHN F. RIESSER, M.D.
Springfield, Ohio

The Use of Cones and Filters to Reduce Patient Dosage in Diagnostic Radiology. R. W. Stanford. Brit. J. Radiol. **30:** 497–499, September 1957. (Guy's Hospital Medical School, London Bridge, London, S. E. 1, England)

This paper presents facts relevant to use of cones, diaphragms, and other devices for beam definition and the addition of filters external to the x-ray tube. The significance of the following three effects in relation to the dose to the gonads is described:

(*a*) Skin dose—male patients when the gonads are unavoidably in the direct beam.
(*b*) Depth dose—female patients when the gonads are in the direct beam.
(*c*) Side scatter—both sexes when the gonads are outside the direct beam.

These three factors are studied and recommendations are made for reduction of the dose received by the patient. The author gives as a realistic approach to the problem three principles:

(*a*) A test of the efficiency of cones and diaphragms and their subsequent modification.
(*b*) Provision of an adequate range of cones and diaphragms.
(*c*) An insistence upon the perimeter of the beam being visible on the film wherever possible.

The use of a proper filter which absorbs radiation contributing to the dose received by the patient but which makes little or no contribution to the blackening on the film is also considered in detail and recommendations are made. Thus, both the skin dose due to direct beam and side-scattered radiation may be greatly reduced while obtaining the same radiographic density.

I. MARC LEGARE, M.D.
The Henry Ford Hospital

Radiation Hazards During Radon Treatment of Eye Lesions. J. Cederlund, K. Lidén, and M. Lindgren. Acta radiol. **48:** 205–208, September 1957. (Department of Radiotherapy, University of Lund, Sweden)

In the treatment of eye lesions with beta radiation from a radon applicator, as practiced in Lund, the radon glass blub has been encased in metal and attached to a 36-cm. rod. For protection, the radiologist has worn lead rubber gloves and apron. No particular steps were taken to protect personnel against the gamma radiation until film badge control was introduced in 1951. The treatment is usually carried out with a 50-mc radon applicator for two minutes, during which time the operator is exposed to from 2 mr at the right foot to over 50 mr to the umbilical area. Since one radiologist treated 10 to 15 patients every other week, it was apparent that further protection was imperative.

To this end a shield of iron blocks was constructed to enclose the patient's head partially during therapy. The device also contains a lead cylinder to hold the applicator when not in use. The result is the absorption of a large proportion of the radiation by the iron, with exposure of the radiologist only during the actual treatment. In addition, the distance between the patient and operator was automatically increased, bringing into effect the inverse-square law.

The protection thus afforded the radiologist is significant, being increased by a factor of ten to the important areas of the body but somewhat less to the forehead and feet. Other personnel continue to receive between 2 and 3 mr per treatment with the added protection.

One diagram; 1 drawing. SAUL SCHEFF, M.D.
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The Treatment of Nausea Following Therapeutic Irradiation. J. E. Lofstrom, Samuel Balofsky, Nicholas Jackiw, and A. J. Spanjers. West. J. Surg. **65:** 306–307, September-October 1957. (1420 St. Antoine St., Detroit 26, Mich.)

Various preparations have been employed for the relief of the nausea and vomiting experienced by a large percentage of patients undergoing radiotherapy for malignant conditions. Of 82 patients treated by radiocobalt at the Detroit Memorial Hospital, 45 (55 per cent) suffered from radiation sickness following therapy. Forty of these patients were given an antiemetic preparation composed of meclizine and pyridoxine (Bonadoxin); 35 (87 per cent) had either dramatic and complete relief of the nausea and vomiting or were definitely improved. Fifteen patients received a placebo at some time during the study; only 2 (13 per cent) reported improvement. Only 4 of the patients in this series were given the placebo alone and none was benefited. Symptoms were mild in 3 patients and required no medication.

Two tables.

Homologous Bone Marrow in the Treatment of Radiation Injury in Mice. C. C. Congdon and Irene S. Urso. Am. J. Path. **33:** 749–767, July-August 1957. (Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

Most of the work on the treatment of lethal total-body irradiation injury in mice by intravenous injection of bone marrow suspensions has been carried out with isologous bone marrow donor animals of the same strain as the irradiated recipient. In these investigations with x-rays, about 95 per cent thirty-day survival was observed, with no appreciable additional mortality during the next few months. Under similar irradiation conditions, exposed mice receiving homologous bone marrow from donor animals of a different strain showed about 50 per cent thirty-day survival with many deaths during the second and third months after irradiation. The nature of the delayed deaths and the clinical features exhibited prior to death form the basis of the present report.

It was found that the thirty-day survival of lethally irradiated LAF_1 mice receiving homologous bone marrow intravenously was often comparable to the survival of those receiving isologous bone marrow; however, most of the animals treated with homologous bone marrow subsequently died of a secondary disease. The histologic changes in the lymph nodes and spleen were compatible with an immunologic tissue reaction. The lesions in the liver, gastrointestinal tract, and skin, and the general state of the mice at time of death suggested a severe metabolic disturbance, presumably initiated by the immune reaction if not actually a part of it. A few animals survived one hundred and seven to three hundred and sixteen days.

The ability of a few mice to escape the delayed homologous bone marrow reaction suggests the feasibility of attempts to circumvent the reaction if proper experimental conditions could be found.

Three photomicrographs; 2 photographs; 3 graphs; 4 tables.